SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, FEBRUARY 14, 1908

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SOME OF THE PRESENT-DAY PROBLEMS OF BIOLOGICAL CHEMISTRY *

DURING the past few decades there has been gradually developing in the biological world a clearer recognition of the importance of a study of function, coupled with a fuller appreciation of the great diversity of the processes characteristic of life. It has come to be the fashion for naturalists—who up to comparatively recent times were content mainly to study form and structure—to turn their attention to observation of function, to learn how and why certain things are accomplished. Each decade has witnessed a broadening of the point of view; in botany, zoology, paleontology and geology new methods of investigation have been gradually applied, new relationships have been established, and the study of life, past and present, has taken on a new and broader significance. The Mendelian law and the present theories of genetics; the facts of modern cytology and the theories of heredity consequent thereto; the present-day experiments in breeding and variation with the conclusions to be drawn therefrom; the modern methods and theories of physiology in general; are the natural outcome of a progressive scientific activity where the study of function has come to occupy a prominent position and where the experi-

* Address of the president of the American Society of Biological Chemists and chairman of the Biological Section of the American Chemical Society, at the joint meeting in Chicago, January 1, 1908.

mental method is being largely applied in biology as in the physical sciences.

The historical and descriptive study of biology has been gradually giving place to experiment. The zoologist is no longer content with systematic work, with the naming and classifying of species and genera, but he seeks to understand the chemical and physical changes that occur in growth, development, old age, death, etc.; or, in other words, he would know the cause or causes of these phenomena. He would understand the reason for things that occur during life, and with that end in view he turns to the experimental method, just as in physics and chemistry experimental or analytical study is made use of in the solving of problems that pertain to these sciences.

In botany, attention is being more and more directed to the study of plant physiology, with its chemical and physical problems. It is not enough to know that some species of fungi, for example, become black at a certain stage of their growth, but we need the explanation of the cause. The enzyme is to be detected and isolated, and the substance or substances upon which it acts identified. So, too, the many phenomena connected with the growth, nutrition and pathology of plants interest us, but knowledge of what is actually occurring can only be had by application of chemical methods. Systemic study of plants and animals will always be important, but if we are to have adequate explanation of the hundred and one phenomena characteristic of living forms we must turn our attention to experimental methods, as is being so largely done at the present time throughout the biological world, with due regard also to possible chemical transformations and reactions, that may be symbolical of broader changes in function and structure.

Descriptive embryology may tell us much regarding development, may show us the many different stages through which the egg, after fertilization, passes on its way to the full-fledged organism, but we gain thereby little or no insight into the causes that are operating to accomplish the ultimate end. We may well conjecture that in fertilization the spermatozoon brings in some chemical elements that constitute the exciting cause of cell division. Assuming such to be the case, we may ask whether it is a ferment substance of the ordinary enzyme type, or whether substances of a totally different character are involved. The answer to this question, however, does not concern us now; but that such a question is pertinent clearly suggests how the cause of cell cleavage may possibly be sought for in chemical or physico-chemical reactions incited by the admixture of germ and sperm substance.

It is well understood to-day that all the phenomena of life are to be explained on the basis of chemical and physical laws, and it is partly because of a clear recognition of this fact that biological chemistry has finally attained the eminence it has now reached as a division of biology; a branch of study that promises much in the ultimate explanation of many of the most intricate of the present-day problems of life. There is another reason why biological chemistry has shown such remarkable development during the past decades, and that is because of the direct aid it has furnished, and still promises to furnish, to physiology and to both experimental and practical medicine. Physiology as an independent science, having to do with the study of function, has grown in keeping with the increasing demand for wider knowledge of the processes of life, and this has led quite naturally to a broader recognition of the importance of the chem-

ical side of physiology, since the physical side has been found inadequate to explain all the varied phenomena of living organisms. As a result, physiological chemistry has developed by leaps and bounds, until to-day special laboratories and journals devoted to this subject are to be found on all sides.

Again, in bacteriology, and in medicine in general, the applications of chemistry are so numerous and so fruitful in results that it is no longer necessary to defend the position of physiological or biological chemistry as a leading factor in the development of knowledge in these subjects. Sooner or later, in almost every problem that presents itself, we are brought face to face with some form of chemical reaction, or some chemical substance, upon which hinges the explanation of the phenomenon in question. Under the broad term of biological chemistry, we are dealing with a subject which, directly and indirectly, concerns itself with the chemical processes of living organisms, and as these are as many and varied as the organisms themselves, it is plain to see that the field is broad and one beset with many difficulties.

The very breadth of our field makes it clear that there will be diversity of opinion regarding the relative importance of the present-day problems in our science. To one man, quite naturally, a certain line of investigation will appeal most strongly, while to another a totally different set of problems will be suggested as the more important and promising. To one, questions of chemical structure and their bearing upon the processes of metabolism will prove most attractive; to another, questions of physico-chemical nature in their relationship to physiological processes in general will appeal most strongly; while to a third, the chemical dynamics or kinetics of physiological processes, the action of inorganic salts and their respective ions upon protoplasmic activity, etc., will seem the more promising field of work. In this latter field, we all recognize the great value of the results obtained in the laboratories here at Chicago, with equal recognition of the broad influence which the theories and conclusions drawn therefrom by Loeb, Mathews and others, have had upon the development and progress of this branch of our science.

Understanding fully the natural tendency of chemists and physiologists to differ somewhat in their estimate of the relative value of the different subjects calling for investigation, we may still, I think, readily select for discussion a certain number of problems in biological chemistry which we shall all recognize as being preeminently important to-day, and the settlement of which would go far toward giving a clearer understanding of many of the functions of the body. Among these problems stands out with startling distinctness the question of the chemical constitution of protein material. To the chemical mind interested in biological matters there is no problem that can overshadow this one in importance. As the basis of cell protoplasm of all kinds, protein stands forth as the one substance or class of substances absolutely essential for life. It is the chemical nucleus or pivot around which revolves a multitude of reactions characteristic of biological phenomena. In all the metabolic processes of animals and plants protein in some form plays a conspicuous part, and its many katabolic or decomposition products testify both to its complexity of structure and to the great diversity of reactions that may accompany its disintegration.

Nowhere is there to be found a better illustration of the physiological power which may reside in a certain definite grouping of elements than is seen in the

case of protein. Gelatin, which resembles albumin in its superficial reactions and which contains approximately the same amount of nitrogen, is, as we know, quite incapable of taking the place of albumin in supplying the needs of the body for protein food. Yet, gelatin yields on decomposition many of the disintegration products furnished by albumin. Still, there are differences in the character and proportion of the cleavage products which, while not sufficiently marked to modify the ordinary protein color reactions, etc., are enough to indicate a difference in chemical structure, and owing to this difference in structure gelatin is quite unable to repair the waste of tissue in body metabolism. To every one at all familiar with protein chemistry the recent advances in knowledge of the hydrolytic cleavage products of this class of substances are more or less known. All proteins by appropriate methods of disintegration break down into a number of monoamino and diamino acids. Thirty years ago these hydrolytic cleavage products were represented mainly by leucine, tyrosine, aspartic and glutaminic acid; but now, as a result of efforts in many quarters, the number of such decomposition products has risen to at least seventeen. The significance of this statement is apparent when we remember that these cleavage products represent the building stones which make up the finished structure of the protein molecule, and if the time ever comes when we know all of these building stones, we shall then without doubt be able to construct or synthesize this most important substance.

Some of the most careful and painstaking work on the hydrolysis of proteins has been done in our own country by Dr. Thomas B. Osborne and his co-workers at New Haven. Examination of the results reported reveals several very important facts. Take, for example, some of the latest data afforded as in the hydrolysis of phaseolin,[1] the globulin of the kidney bean, formerly called legumin. Here, sixteen different cleavage products were identified and determined. The method of hydrolysis and the methods of separating the different amino acids were carried out by persons skilled by long practise and under the best of conditions, yet the percentage of total cleavage products determined amounted to only 54.27. Again, in the hydrolysis of excelsin,[2] the characteristic globulin of the Brazil-nut, the total yield of cleavage products was 61.09 per cent. Finally, in the hydrolysis of hordein,[3] the alcohol-soluble protein of barley, 71.32 per cent. of cleavage products was separated. In other words, by the best methods available and in the hands of skilled workers trained to take advantage of all the knowledge available, chemists are able at present to separate and identify only 54 to 71 per cent. of the total yield of cleavage products which results from the hydrolysis of protein. This undoubtedly means that there are still some building stones in the protein molecule with which as yet we are unfamiliar.

It needs no argument to convince any one that here lies a most important field of work; here is a problem the solution of which gives promise of rich reward, both to the chemist and to the physiologist. Of course, it is possible that the seventeen cleavage products referred to represent all the different types that are formed by hydrolysis and that the apparent deficiency is due simply to inadequate methods of separation. This, however, is not very probable, and it is to be noted in this connection that the results reported by Abderhalden and his co-workers in Germany are

[1] *American Journal of Physiology*, Vol. XVIII., p. 295, 1907.

[2] *Ibid.*, Vol. XIX., p. 53, 1907.

[3] *Ibid.*, Vol. XIX., p. 117, 1907.

not radically different from those obtained by Osborne and others. Far more probable is it that there are still undiscovered a number of component parts of the protein molecule, knowledge of which must be obtained before we can hope to arrive at a synthesis of protein. Physiologists have long sought this goal. It means so much in the unraveling of many intricate problems in protein metabolism, in nutrition in general, in intracellular reactions and particularly those which bear upon the changes incidental to fertilization and cell division.

To how great degree the large variety of proteins of both animal and vegetable tissues have chemical and physiological individuality has long been an unsettled question. There is plenty of physiological evidence that the circulating proteins contained in the blood and lymph of different species of animals are unlike each other in some respects at least. Blood serum from one species introduced into the circulation of another species causes marked disturbance and even a fatal result. Animal proteins are plainly different in some respects from those of vegetable origin, while the latter derived from different sources vary greatly among themselves. We can readily conceive of individual proteins playing quite different parts in the nutrition of man and of animals when taken as food. There may be radical and logical differences in the nutritive value of animal as compared with vegetable proteins, although at present we have no positive proof of such differences. Arguments for or against vegetarianism, which are now based primarily upon questions of sentiment, may in time rest upon a solid foundation of fact. Such observations as have been made bearing upon the constitution of proteins are beginning to have special significance because of the radical differences in chemical make-up shown by the individual proteins studied. Take, for example, phaseolin from the kidney bean. This protein, as shown by both Osborne and Abderhalden, yields about 15 per cent. of glutaminic acid, 4 per cent. of lysine, 2.5 per cent. of proline, 5 per cent. of arginine, etc. Excelsin from the Brazil-nut, on the other hand, yields by hydrolysis 16 per cent. of arginine, 13 per cent. of glutaminic acid, 1.6 per cent. of lysine and 3.6 per cent. of proline; while the hordein of barley yields no lysine whatever, but furnishes 36 per cent. of glutaminic acid and nearly 14 per cent. of proline.

Such differences as these must have some significance; they certainly indicate a totally different assortment of building stones in the finished structure, and it is fair to presume that they carry with them some influence upon the physiological behavior of the proteins when the latter are taken as foods. The gliadin of wheat yields by hydrolysis about 37 per cent. of glutaminic acid, while the casein of cow's milk yields only 11 per cent. Here is indicated a radical difference in structure between the protein of animal origin and that derived from the plant kingdom. We can not say, however, that vegetable proteins are characterized by a high content of glutaminic acid, for while it may be true of both gliadin and hordein, it is not the case with phaseolin or excelsin, both of which yield only a little more glutaminic acid than animal casein. Plainly, we have here a problem not to be overlooked, and in these days of specialized vegetable foods we may justly expect an adequate explanation of the physiological significance to be attached to these chemical differences in structure. The gliadin of wheat, the zein of corn meal and the hordein of barley are all three alcohol-soluble proteins. This solubility in warm alcohol might well serve to place these proteins in a group by themselves, but they plainly are unlike chemi-

cally in some respects at least. There is harmony in the fact that all three yield no lysine by hydrolysis, but zein yields only 11 per cent. of glutaminic acid, while the other two furnish over 30 per cent. of this amino acid. Further, gliadin and hordein yield only about 2 per cent. of tyrosine, while zein furnishes 10 per cent. of this substance. To any one familiar with the known relationship between chemical constitution and physiological action as demonstrated in the study of drugs, the question as to what these differences in chemical constitution signify in the physiological action of three food proteins so closely related otherwise must be a pertinent one.

The present-day conception of the protein molecule is that it is a complex of different amino acids variously joined together. By energetic hydrolysis of the protein the latter is naturally broken apart into simple fragments represented by the monoamino and diamino acids. When the hydrolysis is carefully conducted as by a weak solution of trypsin, various proteoses result as the primary products, *i. e.*, high molecular polypeptides, which by further action of the enzymes may be successively broken down into simpler polypeptides, such as tetra-, tri- and dipeptides. Fischer and Abderhalden[4] a few years ago obtained a polypeptide in the pancreatic proteolysis of several proteins which was characterized by being composed solely of glycocoll, proline and phenylalanine. More recently Osborne and Clapp[5] obtained in the hydrolysis of gliadin what appeared to be a crystalline dipeptide composed of proline and phenylalanine. Further, Fischer and Abderhalden[6] have just described several dipeptides obtained in the partial hydrolysis of proteins; notably, glycocoll and l-tyrosine from silk, glycocoll and l-leucine from elastin and l-leucyl-d-glutaminic acid from gliadin; all characteristic dipeptides. In these results we see suggested the possibility of a primary cleavage of proteins into dissimilar polypeptides and dipeptides with distinct chemical make-up. If such reactions as these do occur, under the influence, for example, of pepsin or trypsin proteolysis, or even through the agency of the duodenal enzyme erepsin, then it is certainly reasonable to consider whether the individual proteoses or polypeptides formed during gastric and pancreatic digestion may not be endowed with different physiological properties. It raises the question whether in the digestion of protein in the gastro-intestinal tract by the enzymes naturally present there a kind of selective cleavage may not occur, in which the various amino acids contained in the protein are split off in special combinations representative of particular lines of attraction or union. Further, a tendency toward the formation of di- and polypeptides having a definite composition, assuming it to exist, may furnish a clue to the way in which the synthesis of protein may be accomplished. Obviously, however, there remains to be discovered first the nature of the 29–46 per cent. of the protein not yet represented by known decomposition products.

The well-known lability of the protein molecule accounts for the ease with which it undergoes hydrolysis, but it is, I think, quite plain that the ordinary cleavage of protein is not the result of a promiscuous breaking down of the molecule. On the contrary, there is satisfactory evidence that certain of the building stones are easily split off, while others are separated with greater difficulty and still others remain combined in large groups or masses,

[4] *Zeitschrift für physiologischen Chemie*, Band XXXIX., p. 81, 1903.

[5] *American Journal of Physiology*, Vol. XVIII., p. 123, 1907.

[6] *Zentralblatt für Physiologie*, No. 15, p. 472, 1907.

thereby suggesting different degrees of attraction or union. Thus, it has been recently shown by Abderhalden and Voegtlin[7] that in the digestion of edestin by activated pancreatic juice certain of the amino acids are rapidly freed from their combinations, while others are liberated much more slowly; tyrosine, for example, was wholly free in two days' time, while glutaminic acid even at the end of sixteen days was split off only to the extent of two thirds of the amount present in the edestin molecule. The same has been found true in the pancreatic digestion of casein; tyrosine is rapidly and completely split off, glutaminic acid, on the other hand, very gradually. Thus, with casein and activated pancreatic juice the full amount of tyrosine contained in the protein was liberated in three days, while, as a rule, glutaminic acid could be obtained free only to the extent of 60–80 per cent. of the amount present and then only after three weeks of continued proteolysis. It is thought, though by no means settled, that alanine, valine, leucine, etc., behave exactly like glutaminic acid, while phenylalanine, proline and glycocoll do not admit of being freed from their combinations at all by the hydrolytic action of pancreatic juice. In other words, we see suggested here different degrees of attraction, different lines of combination among the many units entering into the construction of the protein molecule, which are well worthy of careful consideration, since they may have both chemical and physiological significance. It is no exaggeration to say that every additional fact bearing upon the nature and combinations of the chemical units present in the protein molecule promises to be of the greatest help in unraveling the many complexities now confronting us in our understanding of the nature of this most important substance.

[7] *Zeitschrift für physiologischen Chemie*, Band XXXV., p. 315, 1907.

Any consideration of protein cleavage as a physiological process naturally brings into the foreground enzymatic action in general, which is rapidly becoming recognized as the most important method of chemical change occurring in living organisms. We need go back only a few years when practically our knowledge of enzymatic action as it occurred in man and the higher animals was limited to the transformations of starch, protein and fat by the digestive juices of the gastro-intestinal tract, and in plants to the alteration of starch through diastase. But to-day what a change has come over our understanding of enzymolysis and how widespread the varied processes now included under this term! The bio-chemical reactions which are produced through the agency of the many enzymes so widely distributed in nature are not only numerous, but exceedingly varied in character, and we are practically justified in the assumption that the great majority of the intra- and extra-cellular chemical changes taking place in living organisms are the result of enzyme action. The old-time distinction between ferment action and the so-called vital action of living cells no longer carries weight. As is now well known, not hydrolysis merely, but oxidation, deamidization and a whole host of well-defined chemical changes, such, for example, as are characteristic of the different types of intermediary metabolism in the higher animals, are due to intra- and extra-cellular enzymes, formed, it is true, through the constructive power of living cells, but acting as simple chemical or physico-chemical agents and capable of producing their transformations whether in contact with the cells where they are formed or merely dissolved in suitable extracts free from tissue elements. Not only do these state-

ments hold for the ordinary changes of tissue metabolism in animals and plants, but in that more or less hidden world of microorganisms so potent for good and evil, tangible enzymes are likewise responsible for many, if not all, of the chemical reactions by which the life and activity of the organisms are manifested. New enzymes and new forms of chemical change are constantly being discovered and as a result new light is being thrown upon many phases of tissue metabolism and the processes connected therewith.

Note, for example, the group of unique enzymes concerned in the transformations of nucleoproteins; enzymes which are widely distributed among different species of animals, in different organs and tissues, and which are truly unique in the character of the chemical changes they are capable of producing. Thus, we have nuclease, which splits off or liberates the purines from the nucleic acid complex; adenase and guanase, deamidizing enzymes which are able, by hydrolysis with liberation of ammonia, to form the oxypurines hypoxanthine and xanthine from the aminopurines adenine and guanine; xantho-oxidase, which by oxidation transforms the oxypurines to uric acid; and lastly, a uricolytic enzyme which is able to accomplish the destruction of uric acid with formation of allantoin as one of the intermediary products. Observe how these successive steps in the formation of uric acid from a nucleoprotein are accomplished by specific enzymes, each one of a distinct type and limited in its action to the one transformation. Further, it has been found by several observers that these characteristic enzymes are not common to all active tissues; different organisms show unlike equipment in this respect, thus indicating, as a recent writer has expressed it, that there are "noteworthy variations in the purine metabolism of different species."[8] Consider also arginase which has the power of effecting the hydrolysis of arginine, with production of urea and ornithine; an enzyme present in the liver, kidneys, thymus, intestinal mucous membrane and other tissues, as well as in yeast. Here is an enzyme, according to Dakin,[9] which is adapted for the exclusive hydrolysis apparently of dextro-arginine or of other substances containing the dextro-arginine grouping, and, as in the case of glucosides and sugars, the relation of the enzyme to the substrate is so intimately and finely adjusted that many other substances structurally similar to arginine are incapable of hydrolysis by arginase. Note likewise the newly discovered enzymes creatinase and creatininase,[10] the former of which is apparently able to transform creatin into creatinin, while the latter is said to decompose creatinin, presumably into methyl glycocoll and urea.

Truly, we have in the action of these peculiar enzymes a striking illustration of how in intermediary tissue metabolism successive chemical transformations may be accomplished in orderly fashion, while at the same time there is suggested the probable existence of many other specialized enzymes capable of inciting chemical reactions of equal interest. Is there not possible gain to be had in a broader, more comprehensive study of the intracellular enzymes of animal tissues? Doubtless in each species of animal there are peculiarities of metabolism which are truly specific; probably also there are specific enzymes, the presence and action of which are the determining factors in the special line of

[8] Mendel and Mitchell, *American Journal of Physiology*, Vol. XX., p. 100, 1907.

[9] *Journal of Biological Chemistry*, Vol. III., p. 435, 1907.

[10] *Zeitschrift für physiologischen Chemie*, Band LII., p. 1, 1907.

metabolism occurring. Here is a field of work the cultivation of which promises results of the greatest value, while at the same time broadly applicable. Take, for example, the processes of growth as studied in the earlier stages of embryonic life upwards. What is the character of the processes by which the young organism is able to carry forward its rapid development? What the nature of the chemical changes in the construction and destruction of tissues constantly taking place during growth, where of necessity cell nucleoproteins are conspicuous elements? These questions can not be definitely answered at present, but some work carried on in our laboratory[11] at New Haven has indicated quite clearly the presence of certain specific enzymes early in embryonic life, while others common to the same organs in the full-grown animal are wholly wanting. Thus, it has been found in embryo pigs that the liver contains adenase, but no guanase; the latter enzyme, however, is present in the viscera of the embryo. Further, nuclease is present in the liver of the embryo, indicating that in the embryonic stage of this animal autolytic changes can take place in the liver; *i. e.*, a liberation of aminopurines from the nucleoproteins of the forming hepatic cells, while any adenine set free can be transformed by the deamidizing enzyme adenase into the oxypurine hypoxanthine. Likewise, any guanine liberated can by action of the guanase contained in the embryo viscera be transformed into xanthine. Here, however, reactions of this sort apparently stop in the embryo, at least of this particular species. The xantho-oxidase and the uricolytic enzyme are not present in the embryo, though quite abundant after birth. In other words, in the embryonic, growing organism, oxidative and katabolic enzymes which are obviously concerned in the gradual destruction of the purine part of the nucleic acid complex are wholly wanting; while those enzymes which have to do simply with transformation and alteration of the purines, thereby leading perhaps to the construction of added nuclein complexes, are conspicuous. Here, we see chemical evidence clearly substantiating our conception of the character of the transformations taking place in embryonic tissue; in the embryo, synthetical, constructive processes must naturally predominate, and the chemical mechanism present at that stage of development is designed solely to meet the requirements of synthesis and broad constructive power. Later on, however, when the embryo passes into an independent existence, those enzymes which have to do with katabolism gradually appear, and assume their function side by side with the enzymes primarily concerned in construction.

[11] "Chemical Studies on Growth," Mendel and Mitchell, *American Journal of Physiology*, Vol. XX., p. 115, 1907.

Problems of this character naturally lead us on to a consideration of the chemical aspects of fertilization, cell division, and the relative significance of the cytoplasm and karyoplasm of the egg and sperm cells in heredity, etc. As is well known, the head of the spermatozoon is essentially a cell nucleus, and like other nuclei is composed mainly of nucleoproteins; viz., compounds of nucleic acid with protein material of a more or less basic character. The only substance to be noted in addition is a small admixture of an organic iron compound known as karyogen. The nucleoproteins of the spermatozoon nucleus differ, however, from the corresponding substances present in the somatic cell nuclei in that the protein part of the molecule is made up mainly of some peculiar form of protein such as protamine, which Kossel has defined as the simplest type of protein material known.

These protamines, of which salmine, clupeine, scombrine and sturine are types, are composed chiefly of diamino acids. Thus, as Kossel and Dakin[12] have shown, salmine contains 89.2 per cent. of its nitrogen as arginine, 4.3 per cent. as proline, 3.25 per cent. as serine, and 16.5 per cent. as valine; a total of 98.4 per cent. Similarly, scombrine contains 88.82 of its nitrogen as arginine, 3.8 per cent. as proline, and 6.8 per cent. as alanine; a total of 99.42 per cent. Sturine, on the other hand, differs from the two preceding protamines in that in addition to arginine it contains fairly large amounts of histidine and lysine. From these statements it is plain to see that the basic character of protamines with their large content of diamino acids is much more marked than that of ordinary proteins, such as are found in somatic nucleoproteins. In some species of fishes, the spermatozoon nucleus contains in place of protamine a histone, as the basic substance joined to the nucleic acid. The significant point in this statement is that the histones as a class contain less (about 31–38 per cent.) of their total nitrogen in the form of diamino acids (arginine, lysine and histidine), while the majority of the protamines have 84–89 per cent. of their total nitrogen in this form. Obviously, therefore, the basic portion of the nucleoprotein is subject to decided variation in the sperm of different species of animals, although all are alike in being made up in large measure of diamino acids.

The nucleic acids present in the spermatozoon, as in the nuclei of somatic cells, are composed of a condensed phosphoric acid to which are joined the purine bases adenine and guanine, the pyrimidine derivatives thymine and probably cytosine, with pentose and hexose groups in addition thereto. As expressed by Burian,[13] the two purine bases are joined directly to the phosphorus of the condensed phosphoric acid, so that in all probability a phosphoric acid amide-like combination results. The thymine and cytosine are presumably joined with carbohydrate groups, the latter being in turn bound with the phosphoric acid skeleton after the fashion of an ester. Regarding the cytosine, it is not yet clear whether this substance is a primary component of nucleic acid or a secondary decomposition product of the purine bases. In any event, we have in the sperm nucleic acid a complex substance containing phosphorus in the form of phosphoric acid, nitrogen in the form of purine bases and pyramidine derivatives, together with carbohydrate in the form of pentose and hexose groups. In the sperm nucleus, this acid is combined with a protein, such as protamine, and according to the analyses of Miescher the head of the ripe spermatozoon of the salmon is composed of about 95 per cent. of a neutral salt of salmine nucleate. These are important facts, since they show us something as to the nature of the chemical complex which constitutes the active part of the spermatozoon, and which of necessity plays an important rôle in the synthetical and constructive processes connected with fertilization of the egg and with the later processes of cell division. The dominance of the diamino acids in the protein part of the nucleoprotein (as in salmine) and the corresponding dominance of purine (and pyrimidine) nitrogen in the acid part of the nucleoprotein must impress us as significant when it is remembered that this material is of necessity concerned in the construction of cell, and later, of tissue protoplasm. In making these statements, I have no desire to minimize in any degree the value of other

[12] *Zeitschrift für physiologischen Chemie*, Band 40, p. 565; Band 41, p. 407, and Band 44, p. 342.

[13] "Chemie der Spermatozoen," II., *Ergebnisse der Physiologie*, Band 5, p. 803, 1906.

lines of work—such, for example, as have been carried on so successfully in this university—notably the influence of changing conditions in temperature, oxygen, proportion and nature of inorganic salts, etc., as determining factors in fertilization and cell division. Still, the striking peculiarities in chemical structure just referred to constantly confront us and call for some logical explanation.

It has been one of the accepted doctrines of physiology in the past that in the animal body the protein of tissue protoplasm is the result of a simple transformation of the food protein; digestion in the gastro-intestinal tract leads to the formation of proteoses and peptones, which after absorption are reconverted into such proteins as are adapted to the needs of individual organs and tissues. Latterly, however, this view has been steadily losing ground. The discovery of the enzyme erepsine in the intestine of man and the higher animals, together with its well-established power of quickly breaking down peptones into crystalline fragments, among which the diamino acids stand out conspicuously, has raised the question whether in the intestine prior to absorption food protein is not more or less completely disintegrated with formation among other fragments, of arginine, lysine and histidine, out of which in the liver or elsewhere specific proteins are manufactured *de novo* to meet the needs of the individual organism. There are many grounds for attaching considerable weight to this view, although the question is by no means settled. The facts, however, point clearly to the probability that in digestion the food protein is more or less broken down into amino acids and very simple peptides, and if the organism is to derive advantage from these nitrogenous fragments for the manufacture of protein to make good tissue waste, then synthesis must be the rule. Further, it is easy to see how by such a method of procedure the animal body is able to construct by a proper selection of these fragments the specific proteins needed by different types or species of organisms; far more easily, indeed, than if the changes undergone by the varying food proteins during digestion are limited to such slight transformations as are involved in peptonization, etc. Assuming this view to be correct, we see a close analogy between the construction of body protein in ordinary nutritive processes and the synthesis of protein in those phases of growth and development associated with fertilization and cell division. In both cases, diamino acids, notably arginine, lysine and histidine, are conspicuous elements, but it is to be noted that in the spermatozoon nucleus the protein part of the nucleoprotein is characterized by great simplicity of structure and with a dominance of diamino acids, notably conspicuous in the protamines, less so in the histones. As constrasted with the proteins of somatic cell nucleoproteins, the difference is very striking and must have some significance. The latter are relatively very complex; a complexity which shows itself in a far larger number of building stones, monoamino acids, etc., with a corresponding diminution in the proportion of diamino acids, such as arginine. We can well conceive that in fertilization and the subsequent nuclear changes which precede rapid cell division there must be some inciting element, some conditions prevailing other than those which characterize the somatic cells, and it would seen justifiable to ask if this peculiar chemical structure of the spermatozoon protein, with its high content of diamino acids, may not be in some measure responsible for the characteristic reactions that accompany and follow fertilization. It is certainly a conspicuous fact that the sperm nucleus of many species of animals con-

tains the same kind of nucleic acid as is found in the nucleoproteins of many somatic cells. Here, there is no noticeable difference in chemical structure, but in the protein part of the nucleoprotein the difference, as has been pointed out, is most striking. Hence, it seems reasonable to suppose that some special function attaches to this peculiar structure of the protein present in the nucleoprotein of the spermatozoon nucleus, although it must be granted that at present there are no facts available to support any theory.

We can not avoid attaching considerable significance to this marked chemical difference in the composition of the cytoplasm and karyoplasm of the sperm cell, any more than we can overlook the striking peculiarity of structure in this particular type of cell, in which the nucleus completely overshadows the cell body. We may well ask why the cytoplasm, composed as it is of a highly complicated mixture of different materials, should be so dominated by a nuclear substance composed almost entirely of a nucleoprotein, the basic portion of which is made up of the simplest type of protein known, with its large percentage of diamino acids? The egg cell, on the other hand, is composed in large measure of cytoplasm, and further, the nucleus of this type of cell has a chemical structure radically different from that of the karyoplasm of the spermatozoon, since such nucleoprotein as it contains is widely variant in chemical make-up from the forms present in the sperm nucleus. It is not strange, therefore, that Miescher and others for a time considered protamine nucleate as the important factor in the process of fertilization. Various lines of experiment have apparently demonstrated, however, that such is not the case; still the problem remains, and there must be some explanation to account for these striking chemical differences in the make-up of the karyoplasm in the two types of cells. The chemist and the cytologist are alike unable to find any adequate explanation for the reactions that occur in the commingling of sperm and germ cells. Extracts of various kinds made from the spermatozoon, which might take up some one or more chemical substances as yet unrecognized, have been so far inoperative in inducing fertilization. There can be no question, however, that many of the problems connected with fertilization, cell division, heredity, etc., are bound up in the chemical constitution of the different components of the sperm and germ cells. Chemical activity of some sort is unquestionably incited by the sperm cell, and we may well believe with Loeb[14] "that the direct and essential effect of the spermatozoon and the methods of artificial parthenogenesis is the starting of a definite chemical process," although we are wholly in the dark as to the exact nature of the reactions involved. It might be conjectured that the spermatozoon serves to introduce a positive catalyzer into the egg cell and thereby starts or accelerates synthetical processes by which the egg is made to develop, with consequent transformation of a portion of the cell protoplasm into the specific nuclein or chromatin substance of the nucleus. Experiment along these lines, however, has failed to give any proof of a positive catalyzer being carried into the egg (Loeb).

There may be legitimate differences of opinion as to the relative importance of the nucleic acid and of the protamine base; of their relative significance in the transference of racial and family characteristics, for example. Loeb, however, has said "that the nucleic acid is of more importance for heredity than protamines and histones." This may be so, although the evidence for such a view is not thoroughly

[14] "The Dynamics of Living Matter," 1906, p. 178.

convincing. However, this is not the time to enter into detailed discussion regarding such questions, as the chemical evidence is altogether unsatisfactory and fragmentary. We must rest content at present with the few suggestions already put forward, understanding that our object at this moment is merely to emphasize the need of broader and more exact knowledge in a field of investigation where chemical processes are undoubtedly of paramount importance. The problems involved are many, and future advance is to be looked for from chemists as well as from workers in the fields of morphology and cytology.

Students of heredity are inclined to believe, on the basis of Mendel's experiments on hybridization, etc., that each individual characteristic of a species is represented by a definite determinant in the germ cell. As Loeb has expressed it, "this determinant may be a definite chemical compound. The transition or mutation from one form into another is therefore only possible through the addition or disappearance of one or more of the characteristics or determinants." Look where we will and such suggestions as these are ever before us. We may recognize to the fullest degree the value of the work which has been done, and is still being carried forward so successfully, on the chemical dynamics of physiological processes and the important bearing which the results thereby obtained have upon the problems we are now discussing, yet there is still before us the unanswered question what are these specific determinants that are the carriers of heredity? If their individuality is bound up, as may well be believed, in the chemical structure of the protoplasm, what is the nature of the groups involved? What the character of the ions that are instrumental by their presence or absence in determining processes that are so fundamental in the perpetuation of species or in the production of modifications? Biological chemists may well work with enthusiasm on such a subject, and while it may be that one person's thoughts, for example, will lead him to a study of organic structure, another may be led with equal force to investigate the influence of positive and negative electrons on protoplasmic activity, each equally impressed with the value of his work in its possible bearing on the solution of the problem. Indeed, there is, I think, perfect assurance that both lines of work are called for if there is to be found positive answers for the many questions constantly arising relative to the subject of heredity and the transmission of specific characteristics. The problem is indeed intricate, or so appears at present, and we can only hope for success by following up every line of approach that presents itself.

The topics on which I have ventured to touch in this brief presentation are a small fraction only of those which will arise in the minds of most biological chemists in thinking of our present-day problems. The number is indeed legion. Problems of many kinds confront us of varying degrees of importance, and on their solution depends our rate of progress. The spirit of investigation is abroad and it is our duty, as it should be our pleasure, to exhibit all possible zeal in advancing knowledge of bio-chemical processes. Opportunities in this country have greatly increased of late. The time was, and only a few years ago, when it was a rarity to find a laboratory of physiological chemistry attached to a university. Now, such laboratories are to be seen on all sides, and men of power are being trained to carry on investigation in this attractive and promising field of work. Further, the great research institutions recently established, The Carnegie Institution of Washington, The Rockefeller Institute for

Medical Research at New York, various public health laboratories, the laboratories for research connected with many of the more progressive hospitals and asylums of the country, and last, but by no means least, the agricultural experiment stations with their increased funds, all offer opportunities for progressive work which, if properly taken advantage of, promise results of great importance in the development of a more exact and broader knowledge of the chemical processes of life. To the chemist and physiologist there is nothing to be desired more than an increase in the activity of research; research guided by intelligence and knowledge, coupled with an interest which knows no discouragement.

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THE AMERICAN SOCIETY OF VERTEBRATE PALEONTOLOGY

THE society held its seventh annual meeting at Yale University, New Haven, Conn., December 25, 26 and 27, the following papers being presented and business enacted.

Dr. G. R. Wieland discussed the extermination of green turtles and whales, showing that while the whaling industry had been prosecuted fully a thousand years, in which time some $272,000,000 worth of oil and bone had been obtained, the total number of whales killed was under one million; but the destruction of this relatively small number is fast exterminating these marine mammals. After an animated discussion the society adopted the following resolution:

Resolved, That the American Society of Vertebrate Paleontologists will aid in every way practicable those measures, legislative, international and local, which will prevent the now immanent destruction of the great marine vertebrates, especially whales, manatees, seals and green or other turtles, on the coasts of the United States and on the high seas.

Dr. F. B. Loomis described a fauna of vertebrates (*Portheus, Ichthyodectes, Saurocephalus, Pachyrhizodus, Empo,* etc.) found in the upper black shales making the divide between the Cheyenne River and Hat Creek, Wyo. This fauna being typical of the Niobrara indicated that the upper beds of the so-called Ft. Pierre of that region are Niobrara, and what is beneath would be Niobrara and Ft. Benton.

Dr. W. J. Sinclair showed that the material of the Washakie was practically all volcanic ash, probably distributed by wind and streams.

Dr. G. F. Eaton discussed the skull of *Pteranodon,* showing that the basal portion was peculiar in the development of the parasphenoid, and unique in the possession of diagonal rods running from the base of the parasphenoid to the transpalatines. The origin of the crest was partly attributed to the great development of grasping muscles (connected with the supposed piscatorial habit of feeding) and was compared with incipient crests in the fish eating birds *Plotus* and *Phalocrocorax.* The striking similarity of the pelvis to that of birds was pointed out.

Professor Joseph Barrell read a paper in which evidence was given showing the widespread development of flood plain deposits in the Old Red Sandstones basins and the presence of a fluviatile piscine fauna. The climate was genial and subject to recurrent seasons of dryness. The footprints of the earlier amphibia often show also an association with fluviatile deposits and an adaptation to even semiarid climates. In the discussion of various factors tending to bring about the evolution of the Amphibia the influence of recurrent seasons of dryness upon a fluviatile fauna appeared to be by far the most

powerful. In conclusion the origin of hibernation was discussed and the probable relations of early amphibia and reptilia.

Dr. Wieland exhibited the skeleton of the giant turtle *Achelon,* pointing out the points of morphological importance, and the affinities of the Protostegidæ.

Professor Bashford's presidential address on the "Findings in Fossil Fishes, 1906–1907" appeared in SCIENCE on February 14.

Dr. Hussakof presented a model of a restoration of *Dinichthys,* which emphasized the great head and relatively small body and tail, suggesting a bottom-living fish. He also showed illustrations and specimens giving the exact detail as to the location of the fish-bearing beds in the Devonian of Canada.

Dr. C. R. Eastman announced the discovery of a new species of *Cœlacanthus,* the earliest yet found in this country, and represented by a nearly complete individual, in the basal portion of the Kinderhook limestone of Iowa. The accompanying invertebrate fauna is regarded by Dr. Stuart Weller as a survival of late Devonian times, and its marked Devonian aspect has also been commented on by Professor S. Calvin. The specialized character of the new American form indicates that the ancestors of the group are to be sought in rocks possibly as old as the Lower Devonian, where their remains have hitherto escaped notice. A description of the new form will be found in the *Journal of Geology.*

Professor R. S. Lull presented a comparative study of the musculature of the chameleon and a chelonian, together with the muscle depressions on the skull of *Triceratops,* the main muscles of the latter were ascertained—those of the jaws and of the neck region. The frill or crest seems to have had its incipient function in providing space for attachment of the great temporal muscles of mastication. A second function, that of providing leverage for the wielding of the head, with its great armament of horns, and a final function of protection of the neck, were ascertained. The crest is quite similar to the casque of the chameleon, both morphologically and in function, while the male of the living *Chameleo owenii* from Fernando Po resembles *Triceratops* still further in the development of three horns. Convergence toward the turtles is shown in the beak and the false roofing of the skull above the brain case, culminating in the turtle *Meiolania* of the Tertiary of Lord Howe Island, which also bore horns on the skull.

Professor Lull's second paper considered the migrations of the elephants, first from the ancestral home in the Fayûm of Egypt, and later to and from the great center of proboscidian evolution in India. The American elephants have been the result of successive migrations, one genus only, *Dibelodon,* having reached South America by way of the Isthmus of Panama.

Professor H. F. Osborn discussed "Dolicocephaly and Brachycephaly in Titanotheres," showing that while lengthening or shortening might take place uniformly as if the skull were stretched, still it was more generally to be attributed to local lengthening or shortening of a special part as the face or brain case. On Friday at 5 P.M. Professor Osborn gave an illustrated lecture on his trip into the Fayûm, this being before both the zoologists and paleontologists.

Professor E. C. Case had a paper on the "Permian Glaciation and Distribution of Permian Reptiles" presented; in which he brought out the uniform character of the fauna of Africa, South America and India, and its entire lack of affinity with the North American Pelycosauria. During the Permian glaciation of the southern hemisphere, its reptile fauna was driven northward, surviving in some unknown

locality; later after the glaciation it returned to the southern land mass, there to develop its high variation and specialization. Probably during its exile the mammalian stem arose. The North American Pelycosauria (though having a common ancestry in pre-Permian times) never came in contact with the southern Anomodontia, and played their rôle independently.

Dr. W. D. Matthew described a new four-horned pelycosaur from the Permian of Texas; also a mole from the Lower Miocene of South Dakota.

Mr. Walter Granger, summarizing his studies on the American Hyracotheres, showed that the generic term *Eohippus* covered all the Wasatch, Wind River and Huferno Basin species of the family; *Orohippus* all the Bridger forms; and *Epihippus* all the Uinta forms. He also demonstrated that on premolar 3 of the upper jaw, the last cusp to develop was the anterior-internal, while on premolar 4 it was the posterior-internal which developed last. This striking divergence in the phylogeny of two adjacent teeth causes a demand for much further study, before the history of the various teeth can be summarily treated.

Mr. Harold Cook described a new hornless acerotherine rhinoceros from the Lower Miocene of Nebraska.

Dr. F. B. Loomis discussed the fauna of the Lower Miocene of Nebraska, describing a new *Parahippus,* a hornless rhinoceros (*Acerotherium*) and two new Dicerotheres. A review of the fauna and consideration of the nature of the sedimentation led him to advocate an eolian origin for the beds. The last session of the meeting was devoted to museum methods, the discussion being led by Mr. A. Herrman, Dr. Matthew and Professor Chas. Schuchert.

At the business session the following officers were elected for 1908:

President—Professor R. S. Lull, of Yale.

Secretary-treasurer—Dr. W. D. Matthew, of the American Museum.

Executive Committee—Dr. C. R. Eastman, of Peabody Museum; Mr. O. A. Peterson, of Carnegie Museum; Professor Wm. Patten, of Dartmouth College.

F. B. Loomis,
Secretary

THE NEW EDUCATION IN CHINA

That most popular simile of schoolboy compositions, of Juno springing full-armed from the head of Jupiter, may be applied to the new education in China. From the Chinese government the new education came forth by imperial edict. The edict and the consequent commands and directions present a fully articulated scheme of education.

Four grades of education were made: (1) The primary school, of five years; (2) the common school, of four years; (3) the middle school, of five years; (4) the provincial college, of at least two years, and for some students one; (5) the Imperial University, at Peking, of such a length as may be desired.

Such a course, in its whole duration, covering from sixteen to twenty years, represents a most impressive endeavor to introduce the western system of education into the Middle Kingdom.

The system is indeed western, but it is western colored by Japanese influences. The martial conqueror of China has become her teacher in things intellectual, and more willing has China become to receive her conqueror as a teacher since this teacher has become the conqueror also of Russia. The rapid advancement of Japan to a place among the great nations gives to her example and teachings a peculiar impressiveness. Japan in turn, it may be added, found in Germany and America her intellectual and pedagogical models.

The Avon to the Severn flows, the Severn to the sea;
And Wycliffe's dust must spread abroad, wide as the waters be.

The content of this prolonged course is quite as significant of the modern touch as is its length. Throughout the nine years of the primary and the common school Chinese is the chief subject, representing ten hours a week. Writing covers six hours the first year, but diminishes, becoming only two hours in the ninth. Arithmetic begins with three hours, but increases to four at the close of the course. History and geography begin in the fourth year, each subject being allowed two years, but in the sixth year the allowance of time granted to history is increased one hour, In each year of the four of the common school some science is taught two hours a week, and drawing one. Throughout the whole period two hours are given to ethics and three hours to physical drill.

A similar scheme of equal elaborateness is prescribed in the middle school of five years. In this whole period, Chinese is still studied for six hours. English is introduced, being allowed also six hours; mathematics is continued for four hours, including algebra, geometry and trigonometry as well as arithmetic. Drawing and ethics are also continued, each having one hour, and physical drill still has its former allowance of three hours. Both foreign and Chinese history is studied in the first two years four hours, and in the last three years three hours a week. Such are the "constants" of this higher school course. In addition the "variables" are significant. For four years geography commands two hours a week. For three years four hours a week are given to sciences in which chemistry and physics fittingly occupy a leading place, and allied with them are physiology and hygiene, physical geography, geology and mineralogy. But the sciences are not suffered entirely to exclude literary studies, for political economy and law are studies of two hours a week each for the last year of the long course.

The student who has completed these three schools, the primary, the common and the middle, covering in all no less than fourteen years, has reached the age of at least twenty—the age of the ordinary sophomore in the American college. On reaching this stage he may pass on to the college of his province. He may enter the normal school, preparing himself to be a teacher to his countrymen, in a course covering either one year or three years. This school includes such subjects as would be found in a good American normal school. Or, this graduate of a middle school may desire, probably does, to become an official. In this case he enters a special school. The prospectus of one of these schools—that at Ningpo—says:

> To teach the modern methods of law and government, especially as they are related to those of China, and laying emphasis on the study of Japanese law and methods of government. Resident students must, previous to their entrance, have taken a Chinese degree, or be graduates of a middle school. The course extends over two years and the students who have been successful in their examinations will receive certificates, and will then be recommended by the prefect to the governor for official appointment, or for further study in Peking.
>
> The course of study includes commercial law, theory of government, international law, penal law, judicial law, army organization, Japanese and a little English.

Such, in bare and bald outline, is the educational system which China has adopted. As a system, comprehending the chief subjects of modern learning, it deserves and receives the highest commendation. The government merits great praise for laying such foundations under most serious difficulties.

Schools to teach these studies have been established throughout the empire. Some of the schoolhouses are large and impressive structures. Thousands of these schools are now trying to educate hundreds of thousands of Chinese boys and girls. The

spectacle is one of the mightiest triumphs of education and of government ever known, despite all the haltings and failures to which the undertaking is subjected.

In carrying out the system the making of text-books has become an important factor. Text-books have been produced in enormous quantity and one great variety. Many of them are translations of English or Japanese text-books. In some of them the Japanese influence is strong. Of them all, perhaps none are more important than the Chinese National Readers. The series contains readings on subjects of all sorts—scientific, historical, ethical. It may be added that these books frequently argue against superstition and idolatry. One who knows them has said that they contain nothing which opposes Christianity. But besides this series are numerous others, especially in the sciences. History is also well represented.

But more important than the system of education or the text-book is the teacher. The old Chinese teacher does not easily lend himself to the new order. He is by nature conservative. He clings to the old methods. He is himself so wedded to the old that he confesses to a sort of intellectual awkwardness when he tries to use the new learning and methods. He keeps himself, in his fear of making mistakes, closely to his text-book. He still emphasizes the value of memory. He himself is not a thinker, and he is not inclined to adopt methods which quicken thinking in his students. Modern pedagogy is to him so new a science and art that either he has little appreciation of its worth, or, if he is able to appreciate, he is not able to use it with facility and efficiency.

The teacher, the text-book and the course of study are all designed for the advantage of the student. The Chinese student has a mind strong and virile. The mental quality is akin to the physical. But his mind, like the feet of his sisters, has been fettered by ages of unreasoning limitations. The education of his forefathers has been either no education at all, or, if it has existed, it has been unreasoning and irrational. He himself in his newly-found freedom feels himself strange: he sees trees as men walking. But gradually he is finding himself. His conception of education is rather of a vocation than of culture. The vocation may take on somewhat of a materialistic basis and color. He desires those physical advantages which education is supposed to create. "What are you going to do?" asked a teacher of a graduate—an able man—of Nan Yang College. "Commerce," was the answer. "And why commerce?" persisted the questioner. "Is it for the sake of enriching yourself or helping your country?" The reply indicated that the purpose was not altogether altruistic.

The inspiring motives of the casting off of the old education and the adoption of the new are manifold. The immediate occasion is, undoubtedly, the failure of the Boxer movement of 1900. The entrance of the allied forces into Peking in the summer of that year was the entrance of intellectual light quite as much as of armies. The government became aware, as perhaps never before, that there was a world outside of China, and superior in at least some respects to China.

Connected with this occasion is the rise of Japan into a place as a world power. China saw and was moved. She saw, moreover, correctly—that the rise of Japan was due in part at least to education. China, therefore, determined to adopt similar means and methods. She went about the business of education. Japanese methods, text-books, she adopted. She imported Japanese teachers. She sent thousands, even tens of thousands, of her young men to Japan, to Tokyo, to Waseda University

and other schools. Her old rival, and her conqueror, became her teacher.

A third cause of the educational advancement lies in the force of the progressive men of China. The character of Chang Chih-Tang—one of the two greatest Chinese—and his writing, as, for instance, his book, "China's Only Hope," represent a mighty influence. Against hard odds and good fighters do the progressive leaders contend. Chang Chih-Tang himself has described them in his book:

> The anti-reformers may be roughly divided into three classes:
>
> First, the conservatives, who are stuck in the mud of antiquity. The mischief wrought by these obstructionists may be readily perceived.
>
> Second, the slow bellies of Chinese officialdom, who in case of reform would be compelled to bestir themselves, and who would be held responsible for the outlay of money and men necessary for the changes. The secret machinations of these befuddled, indolent, slippery nepotists thwart all schemes of reform. They give out that it is not "convenient," and in order to cloak their evil deeds rehearse the old story, the usual evasive drivel about "old custom." And if we attempt to discover what this precious old custom in the matter of education and government is, there will be remonstrances on all sides. Old custom is a bugaboo, a password to lying and deceit. How can any one believe it?
>
> Third, the hypercritics.

But against such forces the reform party has won, and is still winning; though no prophet would intimate how long it will prove to be victorious.

But, above all, the missionary and Christian forces of the Middle Kingdom represent a permanent cause of her interest in education. Christianity has not been in China for three hundred years, or for a hundred years with special power, for nothing. Christianity is far more than a religion. It is an education. The church and the schoolhouse historically stand side by side. The priest is also a teacher. Protestant Christianity has for the last hundred years in its missionary propagandism given special heed to education. Such a force operating for generations, even in a most conservative society, could not fail to effect results of comprehensive and also of definite significance.

Under the influence of these four occasions and motives, not to mention others, China has entered into the work of education. She has come to realize that the work is more complex and more difficult than it seemed five years ago. She undertook the tremendous task without proper forethought. It was a leap in the dark. But the leap was taken and the consequences of taking it she must, for better or for worse, endure. What are some of the peculiar difficulties which are now besetting the pathway of education in China I shall discuss in some detail. For these difficulties are formidable and unique.

SPECIAL DIFFICULTIES OF THE NEW EDUCATION IN CHINA

One's heart goes out in great interest to the educationists of China. For the difficulties which beset them are very serious. I doubt if in the history of the world difficulties more serious have beset those whose duty it is to establish and to promote a system of education.

One difficulty lies in the necessary doubt regarding the sincerity and earnestness of the Chinese government in its endeavor to foster the education of its people. The government may be honest in the desire to educate; it may not be. Even if the desire be real as far as it goes, doubt also arises respecting the earnestness and fullness of this desire. The edicts abolishing the old system of examinations followed not long after the cataclysm of the summer of 1900. This break seemed one of the inevitable results of that catastrophe. This and other consequences could not be avoided by the court, however conservative were the governmental tendencies. With these results

were naturally united the necessity of giving to China such a system of education as had seemed to lift the rest of the world into civilization. But with it China did not enter with that spirit which moved the German people after their Napoleonic distresses into education both university and common. The Germans were inspired by most personal and national ambitions; and the result is read in the history of the University of Berlin. The Chinese were primarily moved from without; the degree of cooperation which the outside influence found in the Chinese heart was and still is a matter of grave doubt. This element of doubt in the sincerity and earnestness of the Chinese heart in promoting public education is a chief difficulty which the educationists meet. It is not a stone wall, which can be struck down; it is a malaria which represents conditions that can be dealt with only by indirection.

A second difficulty is the constant change of the educational purposes of "the authorities" and also of the less constant change of these authorities themselves. Shall the provincial colleges be literary or scientific institutions? If scientific, shall they train agriculturists, or mechanical, or civil, or electrical, engineers? In the course of a few years these different purposes may be imposed upon the teachers of a college by their official superiors—superiors who are superiors in only the official sense. Such changes are disastrous. No less disastrous are the changes wrought in the transfer of governing powers from one official board to another. At one time Nang Yang College, at Shanghai, for instance, may be under the charge of the Board of Agriculture, and at another under the charge of the Board of Communications—Post and Telegraphic. At one time a college may have a president who serves as the source of immediate authority, at another it may have no president, but be governed by a council. The changes, too, in the viceroys of the different provinces may fundamentally affect the fortunes of a college. One viceroy esteems education and promotes it; his successor may despise it and seek to limit its progress. All these conditions throw doubt into that most important part of college administration—the budget. Such instability is most trying and perplexing to the heart and the mind of the educationists of China.

Another difficulty lies in the divorce which has for many centuries existed in China between the scholar and the man of affairs. The scholar, be it always remembered, has from the early time held a high place in Chinese society. The learned man has been esteemed, and learning honored. The learning has, however, been an end in itself. The scholar has filled his mind with the paragraphs and the sentiments of the old moralists. Such stuffing has given him pleasure. That his knowledge should be of any worth or benefit to humanity has been quite foreign to his thought. Most egoistic has he been; and the community has been content to let him be egoistic. But modern education has for its primary note service. It is in purpose, method and content altruistic. If it promotes scholarship and makes scholars, it looks beyond the accumulation of knowledge to the worth which this wealth may prove to be to humanity. It is the introduction of this altrusitic ideal which the teachers of many Chinese schools find of great difficulty.

Allied to this specific course is a general condition, out of which possibly the cause to a degree springs. I allude to the doubt which pervades at least some orders of Chinese society regarding the real worth of human character. Is man, the ordinary man, worth educating? Is it well for man to seek to lift man by education? Once a

coolie, why should not a coolie be always remain? Is not education disquieting to the individual and disturbing to society? Is it not better for man to be half blind and content than to see plainly and be discontented? Such questioning is in the air at Peking, Wauchang and Shanghai. It serves, if not to cut the name of education, at least to dull its enthusiasms.

But the severest difficulty found in the progress of Chinese education lies in the lack of a sufficient number of good teachers. The government, provincial and national, went into the work of education as a sort of leap into the dark. It adopted and created the material forms and forces of education, which are evident and impressive enough. It built schoolhouses, large and long and high. In not a few capitals the schoolhouses are the most impressive structures. But the government failed to take proper account of the fact that, if it is easy to build a schoolhouse, it is hard to get a teacher. Teachers can not be made in a year as can a schoolhouse. The government did not put the cart of the school before the horse of the teacher, for though there was the cart there was no horse. Teachers in a sense are grown; and growth, unlike manufacturing, takes much time. Therefore, while there were and are schoolhouses, and also pupils, in abundance, too great abundance in a sense, there was and is a dearth of teachers. The gun was made and mounted, but there was no gunner to fire it. In such a dearth incompetency flourishes. But the dearth was and is so great that the number of even incompetent teachers proves to be insufficient. Some schoolhouses are, therefore, houses without schools, and other schoolhouses are only half occupied. In such a condition Japan would even now be plunged, had she not established normal schools—and some excellent ones, too—for training teachers. This need of Japan President Eliot pointed out a generation ago. China has normal schools, but they are new, and they, too, lack proper teachers. The fact is that China went into this great work of the education of a quarter of the population of the globe without proper prevision or provision. The mission schools and colleges, such as St. Johns, at Shanghai, and the North China Union College, near Peking, are implored by the government officials to send teachers to the government schools, but these colleges and others like them, in many cases, can not, simply because the supply is inadequate.

It may be said that the dearth of good teachers in the government schools of China should prove to be an impressive fact to the American man who is graduating at his college. Teachers of English and of the sciences are specially needed. Many motives, selfward and altruistic, would urge him to go to China on graduation. He can earn twice as much money as a teacher in China as he can at home. He can gather up into his manhood experiences, new, diverse, moving and enriching. Whether he can do more good than at home is a personal question, in which a stranger should not meddle. But, if meeting responsive minds, eager and by nature strong, which are to become makers of other minds, represents an opportunity for doing much good, certainly the Chinese government schools represent a very rich opportunity.

These difficulties which I thus outline are very general and constant. The teachers now on the ground are dealing with them as best they may. Both foreign teachers and native are laboring together to overcome what obstacles they can not remove, and to remove all that can be removed. The problem is hard. The quantitative relation is significant. To educate four hundred millions is a problem unlike edu-

cating forty millions—as in Japan. In their endeavors the present teachers of China deserve sympathy. To condemn the inadequacy of Chinese education—and it is inadequate—means ignorance of the conditions. Sympathy should be given by the teachers of the world to their professional brethren in China, and reenforcements, too. For these reenforcements the Chinese government is loudly calling.

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SCIENTIFIC BOOKS

A Text-book of Physiology for Medical Students and Physicians. By WILLIAM H. HOWELL, Ph.D., M.D., LL.D. Second edition. Philadelphia and London, W. B. Saunders Co. 1907.

"Economy," wrote Burke, "consists not in saving, but in selection." This principle Professor Howell has applied in writing his text-book of physiology. Instead of attempting to condense the great mass of fact and theory which constitutes the body of present-day physiology, he has chosen subjects which have seemed to him most desirable for the man with medical interests to know. And these subjects he has presented with simplicity and lucidity. The result of this method has been the production of a treatise which states with a fair degree of completeness the facts and theories of many important phases of physiology, while other phases are wholly eliminated. The method permits the writer to avoid the bleak statements of fact which characterize attempts at too great condensation, and allows a variety and discursiveness, at times into the historical development, at times into the practical bearings of the subject, which are entertaining. This text-book has already been used two years by medical students, and they report to their instructors, "Howell is interesting reading."

The first exception which might be made to a text-book based on the principle of elimination rather than condensation is that the writer may emphasize his special interests and may eliminate subjects which seem important to others. Fortunately Professor Howell's extensive experience as a teacher and investigator in different medical schools has served him well. This experience, together with the fact that in all the larger medical schools in which the laboratory method is an important feature of physiological training the subjects taught do not greatly vary, has led to a selection of material which would be generally admitted as desirable for students of medicine to know, and to the elimination of little that is at present medically important.

The first section of the volume deals with the physiology of muscle and nerve—the fundamental tissues for most of the systems which follow. The second section on the physiology of the central nervous system is concerned with the governing agent of the muscular structures already studied. A discussion of the physiology of sleep in this section is an unusual and commendable chapter in a physiological text-book. Treatment of the special senses as the recipients of stimuli for the central nervous system is taken up in section three. Blood and lymph are next considered as a preliminary to section five which is devoted to the organs of circulation. The discussion of the physiology of respiration in section six, and digestion and secretion in section seven presents further application of the fundamental activities studied in the earlier chapters. In all these general subjects the chemical side of the physiological activities has received due recognition. This is also true of the treatment in section eight of nutrition, and heat production and regulation. The formal exposition closes with an excellent account of the physiology of reproduction. An appendix, however, gives a brief description of proteins and their classification, and a clear statement of some of the facts and principles of physical chemistry in their application to physiological processes. The large array of original illustrations is a pleasing feature of the volume.

In this second edition a number of small errors which crept into the first edition have been corrected, and additions have been made with the object of keeping the book abreast of the times. As far as possible, however, these

additions have been counter-balanced by the elimination of material which could be spared, and the volume, therefore, remains of practically the same size as in the first edition.

At this time when physiological facts and methods are becoming more generally recognized for their importance in experimental pathology and surgery it is highly gratifying that so excellent a treatise as Professor Howell's can be placed in the hands of students who are to become the future investigators and practitioners of scientific medicine. So few text-books are written now-a-days by men who are themselves active in research that the spirit of research rarely is expressed in them. This book, however, is an exception to the rule. Professor Howell has not hesitated to bring before his readers phases of physiology in which the conclusions are not yet settled; the student is thus made to see that there are live issues in the determination of which he may himself engage. Other evidence of the hand of the scholar in this book is the presence of numerous references to the original sources. This feature, likewise, is so unusual in the conventional text-book that it is worth noting and commending as admirable. By these methods the student may be led to take no secondary account as final authority, but to base his judgment on the weighing of first evidence. It is a real pleasure to find these scholarly qualities in an American text-book widely used by American students.

WALTER B. CANNON

The Microscopy of Technical Products. By Dr. T. F. HANAUSEK, Director of the Gymnasium at Krems on the Danube; Member of Various Imperial Commissions and Learned Societies; formerly Professor of Natural History at Vienna, Analyst of the Government Food Laboratory at Vienna, etc. Revised by the author and translated by Andrew L. Winton, Ph.D., Chief of the Chicago Food and Drug Laboratory, Bureau of Chemistry, U. S. Department of Agriculture; formerly in charge of the Analytical Laboratory of the Connecticut Agricultural Experiment Station, with the collaboration of Kate G. Barber, Ph.D., Microscopist of the Connecticut Agricultural Experiment Station. With 276 illustrations. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1907. Cloth, $5.00.

With the development and application of scientific methods in all lines of industry and with the increasing use of the microscope in the analysis of various raw and manufactured products, the need for books dealing with its application in this field is being felt in this country as well as abroad, and we in this country are highly indebted to Dr. Winton for making available first the valuable work of Moeller on food products and now the work by Hanausek on technical products.

As stated in the preface, Hanausek's work is intended on the one hand as a text-book for the "student entering the field of technical microscopy," the requirements being that he shall possess a general knowledge of the natural sciences, particularly the morphology and histology of organisms, and shall also be familiar with the principles of chemistry; and on the other hand, as an aid in the solution of practical problems. Thus, as stated by the translator, the book "is unique in that it teaches the microscopic identification of technical products and at the same time the fundamental principles of vegetable histology and the histology of certain animal materials" as well.

The author's reputation as a teacher, investigator and technical expert, and the translator's ability and experience as an analyst, assure at once the high character of the work and bespeak for it a wide use in this country.

The book covers some 471 pages, and is divided into two parts. Part I. includes three chapters and deals with the microscope, microscopic accessories and micro-technique. Part II. embraces nine chapters, and treats of the microscopy of the most important types of technical raw materials under the following heads: (1) Starch and Inulin; (2) Vegetable Fibers, including hairs, the fibers of monocotyledonous and dicotyledonous stems, and the microscopic examination of paper; (3) Animal Hairs, Silk and Silk Substitutes, Mineral Fibers, and Microscopic Examination of Textile

Fabrics; (4) Wood of Dicotyledons and Gymnosperms, Monocotyledonous Stems, Subterranean Organs, Barks, and Practical Examples; (5) Leaves of Different Varieties of Sumach; (6) Pyrethrum or Insect Powder; (7) Technical Fruits and Seeds, Oil Cakes, Myrobalans, Ivory Nut; (8) True Bones, Teeth, Horn, Tortoise-shell and Whalebone; (9) Micro-chemical Analysis.

The reviewer is using both the work on "The Microscopy of Vegetable Foods" and on "The Microscopy of Technical Products" in the laboratory, and finds them very helpful. Pure botanists would do well to have these books in their laboratories where plant histology is considered, as there is no doubt but that much of the work on the anatomy of plants has been developed by the investigators in technical histology.

HENRY KRAEMER
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Archiv für Optik; Internationales Organ für Experimentelle, Theoretische und Technische Optik. Erster Band; Erstes Heft, Oktober, 1907. Herausgegeben von Dr. ALEXANDER GLEICHEN, Kaiserl. Regierungsrat in Berlin, unter Mitwirkung von (some twenty astronomers, physicists and optical specialists). Verlag von Veit und Comp. in Leipzig, Preis des Bandes. 20 Mark.

The establishment of an international journal in any important field of scientific activity is nowadays a decided step toward that internationalism in science and that pure human cooperation which are earnestly desired by the best and brightest people of all lands. Astronomy has for two centuries led the way in this genuine internationalism, but many other sciences are now enlisting under the same standard.

As a general rule the journal of international scope should be published in the country which may naturally be expected to contribute most efficiently to its pages. A fine type of such a publication is the *Astrophysical Journal* published in America, where astrophysical science flourishes most luxuriantly. It has, however, received the hearty support of men of science in all lands. Its pages are enriched by the world's best thought in the great field of astrophysics.

The *Archiv für Optik,* as an international organ, ought naturally to be published in Germany. In many respects German thought has led in theoretical optics, and the German hand executed some of the finest experimental and technical results in all optics. To-day no great general treatises in technical optics exist outside the German language. It is also peculiarly fitting that the same international cooperation should be given the *Archiv für Optik* that has in the collateral field been accorded the *Astrophysical Journal.*

Dr. Alexander Gleichen, if we may judge from the theoretical thoroughness and practical tone of his writings, is well equipped to guide so difficult and important an undertaking as a world-journal in general optics. His "Lehrbuch der Geometrischen Optik," Leipzig und Berlin, 1902, has an international reputation. His "Vorlesungen über Photographische Optik," Leipzig, 1905, is indispensable to technical students in optics, and his "Leitfaden der Practischen Optik," Leipzig, 1906, is an excellent introduction to the fundamental theory necessary in optical practise.

The first number of the *Archiv* contains "Tatsachen und Fiktionen in der Lehre von der Optischen Abbildung," by Allvar Gullstrand, of Upsala; "Über ein neue Verfahren der Körpervermessung," by C. Pulfrich, of Jena; and "Patentschutz für Optische Systeme," and "Zum Gedächtnis von Siefried Czapski," by Dr. Gleichen. Then follow trenchant reviews of eighteen current articles on physical optics; of two on astronomical and meteorological optics; of one on medical and biological optics; and of one on technical optics. Dr. Lummer's new volume on optics receives detailed notice; and a complete list of optical articles read before various scientific academies is presented. F. Plehn makes a valuable contribution to the history of optics by reviewing Kepler's "Paralipomena ad Vitellionem seu Astronomiae pars optica." Then follow interesting selections from scientific societies, namely, Max Wolf "On the

Milky Way," and Sigmund Exner on "Acuteness of Vision of Various Animals." The new German optical patents and instrumental designs are reviewed. The optical ateliers and their novelties receive a page of attention. Mention of new books and personal notices close the number.

The far-reaching significance of the appearance of this international journal on optics should be promptly appreciated. Glancing over the achievements of America's men of science in the field of optics during the last quarter of a century, and calling to mind the present manifold American activity in all kinds of optical enterprise, it seems that many interesting contributions ought to be made to this journal from the land of Alvan Clark, Henry Draper, J. Willard Gibbs, Henry A. Rowland, James Keeler, Samuel P. Langley and D. B. Brace.

The *Archiv für Optik* will, of necessity, be at the command of every American student and worker in optical fields. And the deeper interest in theoretical and practical optics to be awakened by this special journal will find concrete expression in more powerful optical instruments, largely of American design and manufacture, and in their manifold and ever-multiplying scientific uses.

M. B. S.

SCIENTIFIC JOURNALS AND ARTICLES

IN the December number of *The American Naturalist* the editor, Professor Frederic T. Lewis, of the Harvard Medical School, says: "*The American Naturalist* now completes its forty-first volume. With the development of the natural sciences in this country, in which it has had an important part, many technical journals have appeared; but these have not deprived the *Naturalist* of its special field. Although dispensing with its early subtitle—A Popular Illustrated Magazine of Natural History—it has always aimed to present in readable form an account of the progress of natural history, together with original articles on such animals, plants, and geological formations as are of general interest. In accomplishing this without the usual endowment or support of any scientific society, the journal has depended upon its owners and the public for financial support, and upon the unpaid work of editors and contributors for its success. Messrs. Ginn & Company have decided to discontinue as publishers with the completion of this, their tenth volume. It is thought that to justify the work now being expended upon the journal, it should have a wider circulation and more generous support. The means of accomplishing this are being discussed, and the owners will be glad to receive practical suggestions from those interested." It has now been arranged that the *Naturalist* will in the future be published by The Science Press, and business communications should be addressed to Sub-station 84, New York City. Editorial communications should be addressed to the Editor of the American Naturalist, Garrison, N. Y.

The Museums Journal of Great Britain for December, 1907, contains a brief article by H. C. Bumpus, on "The New Museum at Frankfurt" which is commended, among other things, for the ample provision made for laboratories, and for a staff to use them. Huntly Carter tells "How to Promote the Use of Museums by an Institute of Museums." In spite of many good points this article strikes one as rather unpractical and to imply a willingness on the part of the public to study the workings and uses of museums that the same public is very far from possessing. Among other notes is an item to the effect that work has begun on a new wing for the National Gallery.

The Zoological Society Bulletin for January opens with an article by C. William Beebe on "New Rare Birds in the Zoological Park." Notable among these are the lammergeier, the hyacinthine macaw and the touracous. The park now contains 2,400 birds representing 520 species, perhaps the largest collection of living birds in the world. The principal article is by Elwin R. Sanborn on "The National Bison Herd," an account of the transportation of the herd of fifteen bison, presented by the Zoological Society to the national government, from New York to the Wichita range; the article is admirably illus-

trated. Mr. Ditmars records the reception of a toad, *Scaphiopus hammondi*, said to have been exhumed from limestone, at a depth of 150 feet, at Butte, Montana. As limestone is notable for caves and fissures there is nothing impossible in the specimen having lived out of sight long enough for the color pattern to have faded. It has now lived in a porcelain jar for eight months without feeding. But a rattlesnake has been known to exist seventeen months without eating and snails from three to eleven years. We trust that the future record of this toad will be carefully kept.

The American Museum Journal for January is a paleontological number. W. D. Matthew describes the recently mounted skeleton of "Allosaurus, a Carnivorous Dinosaur," and "The New Ichthyosaurus," this last one of the rare instances in which the shape of the paddles, tail and dorsal fin of this marine reptile are clearly shown. Walter Granger gives "A Preliminary Notice of the Fayûm Collection," which secured some 600 specimens of fossil vertebrates, and there are notes on ethnological material from the Congo, and the Bismarck Archipelago.

The Museum News of the Brooklyn Institute for January has articles on "Zuni Basketry," "Arctic Foxes" and the "Tree Frog and Protective Coloration."

The Bulletin of the Charleston Museum for December is mainly devoted to the "History of the Museum" subsequent to 1850, although it notes the preparation of the first loan, or traveling exhibit, devoted to illustrating the iron and steel industry.

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

The 437th meeting was held January 11, 1908, President Stejneger in the chair.

The first paper, by Mr. E. W. Nelson, of the Biological Survey, on the "Distribution of Plant and Animal Life in Lower California," was in the form of a lecture illustrated by many lantern slides during which he gave a brief resumé of his recent expedition to the Peninsula of Lower California. The peninsula, which is about 800 miles long and from 30 to 100 miles wide, was traversed its entire length and crossed eight times from one side to the other. The country proved to be mainly a mountainous desert subject to prolonged periods of drought during which no rain falls for several successive seasons. As a result surface water is very scarce.

The most interesting feature of this region is its plant life, as it has probably developed the most remarkable desert flora of the world. On the other hand, the bird and mammal life is very closely related to that of southern California. The birds and mammals in most cases are either the same as, or merely geographic races of, the Californian species. As would be expected, the greatest amount of differentiation has taken place in the mountains near the extreme southern end of the peninsula. Only about half a dozen birds and a single mammal, a species of mouse (*Oryzomys*), are derived from the opposite mainland of Mexico. These species all live near the southern end of the peninsula.

The second paper, by Dr. D. T. MacDougal, was a lantern slide lecture devoted in large part to "Changes in the Delta of the Colorado River."

During a visit to the lower part of the delta of the Colorado River in March, 1905, a great volume of flood water was seen to be leaving the main channel and making its way southeastwardly to the gulf through the Santa Clara Slough, and the prediction was hazarded that a shift of the cutting action of the water might send the principal current to the sea in this way (*Bull. Amer. Geog. Society*, January, 1906).

Shortly after that observation was made, the entire stream was diverted into the Salton Basin for a time, leaving the bed of the river bare for more than a hundred miles. With the restoration of recent conditions the Colorado resumed its way to the Gulf, but in the meantime, such erosion and formation of bars had taken place in the section affected by the tides below the "Colony mesa," that the main current flowed through the Santa Clara Slough, if reports from three different sources are to be credited.

The consequences of this change are somewhat momentous. The main mouth of the river was formerly twenty or thirty miles farther north of the new débouchure, and with the converging shores of the gulf, gave conditions which with the spring tides at thirty to forty feet, produced a marked bore, being felt many miles upstream, both in the Colorado and Hardy. The new channel reaches sea-level by a much more gradual descent and hence without the strong current favorable to developing the bore.

The new mouth will become the center of a new series of mud flats which fringe the shores already for a distance of fifty miles, The deposition of silt will operate to close the eastern channel between Montague Island and the mainland, which has long since ceased to be navigable and will soon afford material which will be piled by the tides in the deeper channel to the westward with the final result of filling it more or less completely.

The new eastern channel is one probably not previously occupied by the river in its present condition, and the change adds to the delta the triangular area enclosed by the old channel below the "Colony mesa" to the gulf, and the new channel, inclusive of expanses of mud flats and a range of gravel dunes or hillocks which find their culmination at the extreme northern end of the triangle immediately below where the new channel takes off from the old one.

In addition to increasing the area of the delta, serious disturbance of the plants and animals over an area of several hundred square miles may ensue. In a large part of it the composition of the flora will be totally altered.

M. C. MARSH,
Recording Secretary

THE TORREY BOTANICAL CLUB

THE first stated meeting for 1908 was held on January 14, 1908, at the American Museum of Natural History at 8:15 P.M. Vice-president Edward S. Burgess presided. The attendance was fourteen.

This being the annual business meeting of the club, the chairman called for the reports of officers for 1907. Reports of the secretary, treasurer, editor and corresponding secretary were read, accepted and placed on file.

The secretary reported that fourteen regular meetings had been held during the year, with a total attendance of 306, as against 219 in 1906, and an average attendance of 21.8, as against 16.8 last year. A total of 37 formal papers was presented before the club, distributed according to subject-matter as follows: taxonomy, 5; physiology, 6; morphology, 4; ecology, 7; regional botany, 5; exploration, 2; lantern lectures, 4; miscellaneous, 4. In addition to these were numerous informal notes and exhibitions of specimens.

The editor reported the publication of one number of the *Memoirs,* of 47 pages, and the issuance of the *Bulletin* and of *Torreya* as usual. The need of an adequate index to the *Bulletin* from volume one to thirty, inclusive, was strongly emphasized.

On behalf of the committee on the local flora, the chairman, Dr. Britton, urged the need of increased activity, and emphasized the desirability of preparing a special work on the flora of New York City and vicinity. At present no such work exists.

Election of officers for the year 1908 resulted in the election of the following ticket:

President—Henry Hurd Rusby.

Vice-presidents—Edward Sandford Burgess and John Hendley Barnhart.

Secretary—C. Stuart Gager.

Treasurer—William Mansfield.

Editor—Marshall Avery Howe.

Associate Editors—John Hendley Barnhart, Jean Broadhurst, Philip Dowell, Alexander William Evans, Tracy Eliot Hazen, William Alphonso Murrill, Charles Louis Pollard and Herbert Maule Richards.

C. STUART GAGER,
Secretary

DISCUSSION AND CORRESPONDENCE

THE TEMPERATURE OF THE SUN

PROFESSOR SCHAEBERLE'S measurement of the effect of concentrated solar radiation in the melting of platinum and other metals[1] is a valuable addition to previous experiments of this sort. Indeed, it may be doubted whether the measurement has ever been made before

[1] SCIENCE, December 20, 1907, p. 877.

with a mirror of so great concentrating power, which at the same time has possessed so perfect a figure.

The energy received from the sun can not be determined from the data given without further addition of a time-factor, and estimates of the mass of material heated, and of the accompanying losses of heat. As a simple experiment in static equilibrium of temperature, however, this knowledge is not necessary.

It is doubtful whether radiation formulæ obtained from measures through a limited range of temperature for solid bodies, composed of complex molecules, are applicable to solar conditions at the photospheric level, where it is improbable that any molecules remain undissociated. Extrapolations from Stefan's law of the proportionality of total radiation from a black body to the fourth power of the absolute temperature, are therefore not certainly applicable to the problem, even though the law has been verified through a range of some hundreds of degrees. But, on the other hand, Newton's law, which is only an approximation for a very limited range of temperature, and which becomes entirely erroneous when we pass to wider variations, is even less trustworthy.

If the exposed body were at the center of a perfectly reflecting, hemispherical mirror, it would receive as much heat as if it were transported to the sun's surface, neglecting the loss by atmospheric absorption. At the focus of such a mirror, since the radiation received or lost is proportional to the solid angle filled by the mirror, or by the portion of the sphere outside the mirror, respectively, the body would receive more solar radiation than from the actual mirror, subtending 29°, in the proportion, versin 90°: versin $14°.5 = 31.3:1$.

At the same time, the angle through which loss of radiation from the heated body takes place, having been diminished in the ratio, $1.968:1$, the total radiant effect would be altered in the ratio, $1:1.968 \times 31.3 = 1:61.6$. Accepting the estimate of losses by absorption, this ratio is to be further multiplied by 2.14, giving $1:131.8$. With the estimated temperature of 2,000° C. from solar rays with an 18-inch aperture, we get, if the sun radiates as a full radiator and Stefan's law holds, effective solar temperature $= t_0 = (2{,}000^4 \times 131.8)^{\frac{1}{4}} = 6{,}776°$. This is a minimum value, because the sun does not radiate as a body at a single definite temperature, but as a complex radiator, since, even if the photosphere behave like an absolutely "black," or full radiator, the atmospheric layers above the photosphere, which are at a lower temperature and which add their own radiations, can not be perfect radiators, because they would then be perfect absorbers also, and would completely absorb and shut off the radiation from the photosphere itself, becoming a new photosphere in turn.

We may presume that quite a notable amount of radiation comes from these cooler and imperfectly radiating layers, enough, at any rate, to cause the maximum in the spectral energy-curve to move from the position corresponding to the photospheric temperature to one appropriate to a body of lower temperature, through the addition of a disproportionate amount of radiation of longer wave-length.

To produce a given amount of radiation from an imperfect radiator requires a higher temperature in inverse proportion to the coefficient of relative emissive power. Scheiner has noted this in his treatise on the "Radiation and Temperature of the Sun," and has estimated that it may be necessary to almost double the temperature which would be obtained on the supposition that the sun is a perfect radiator.

The complexity of the solar radiating layer prevents the strict application of Paschen's law connecting the wave-length of maximum radiation and the absolute temperature, to the problem of solar temperature; but there is now sufficient agreement in the different modes of computing the solar temperature to indicate that it is between 6,000° and 7,000°, or else that there is a marked change in the law of radiation at solar temperatures, a possibility which has been suggested by Professor Bigelow.[2]

It does not seem demonstrable that the effective solar temperature is as great as 66,-

[2] *Monthly Weather Review*, December, 1902, p. 561.

000° C., the value assigned by Professor Schaeberle; but neither is it demonstrable that the temperatures assigned by Stefan's law are correct; and nothing but the existence of certain coincidences in values given by different methods, coincidences which are possibly fallacious, can be said to favor the supposition that the effective temperature is as low as 7,000°.

Since about nineteen twentieths of photospheric radiations of wave-length 0.3 μ are absorbed by the sun's atmosphere, and of rays of wave-length 0.4 μ barely a fifth get through, the form of the spectral energy-curve is so much changed near the maximum that the position of this important point in the curve of photospheric radiation, restored by application of corrections for the absorption by the atmospheres of sun and earth, becomes uncertain; but the photosphere can not have a temperature as great as 60,000°, nor even one of 10,000°, without requiring serious changes in the constants of radiation in the formulæ accepted to-day, or in the assumptions tacitly made as to the emissive power of the solar substances. The latter may very likely be in error, and it would be interesting to have measures of the relative emissive powers at very high temperatures of all substances which can give continuous spectra at those temperatures.

FRANK W. VERY

WESTWOOD, MASS.

THE FAUNA OF RUSSIAN RIVER, CALIFORNIA, AND ITS RELATION TO THAT OF THE SACRAMENTO

FOLLOWING an article in a recent number of SCIENCE[1] on certain "Physiographic Changes bearing on the Faunal Relationships of the Russian and Sacramento Rivers, California," a note on the fish faunas of these basins may be of interest. The writer of the present paper has seen no account of the fishes of the Russian River, and therefore must rely entirely on his own observations for the following statements.

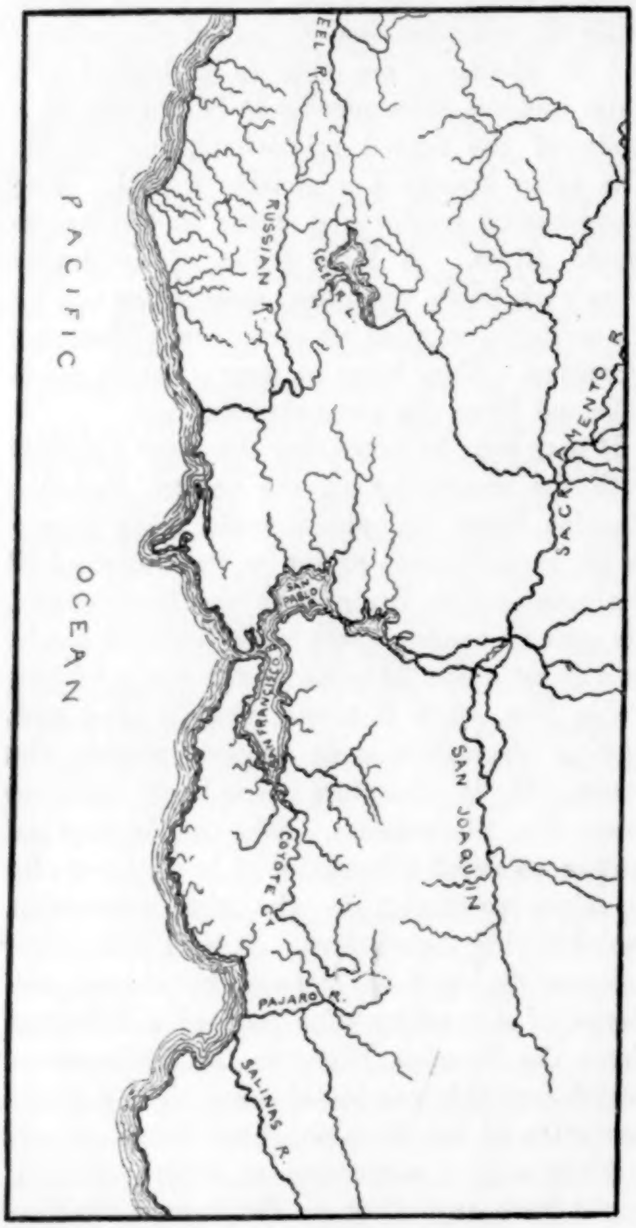
The Russian River has, so far as known, twelve species of indigenous fishes. They are: *Entosphenus tridentatus, Catostomus occidentalis, Mylopharodon conocephalus, Ptychocheilus grandis, Rutilus symmetricus, Oncorhynchus tschawytscha, Salmo irideus, Gasterosteus cataphractus, Cottus asper, Cottus gulosus, Cottus aleuticus* and *Hysterocarpus traski*. Of these, *E. tridentatus, O. tschawytscha* and *S. irideus* are anadromous forms, while *G. cataphractus, C. asper, C. gulosus* and *C. aleuticus* are able to withstand salt water and are consequently to be ignored in a study of the faunal relationships of rivers. The other species are strictly fluvial. The above-named species also occur in the Sacramento River. A large series of specimens from each basin, examined some years ago by the writer, presented no structural differences whatever. They were as near alike as fishes collected from the same stream.

It may here be noted, for those not familiar with the geography of the region, that the Russian River occupies a basin lying mostly in the mountainous region to the westward of the great valley drained by the Sacramento. Its general course is southward until it reaches a point about 35 miles to the north of San Pablo Bay, when it turns abruptly west and, flowing through a deep canyon, reaches the ocean. It is therefore completely isolated from the Sacramento. The headwaters of numerous small tributaries of both rivers rise in close proximity in the high mountains which divide their basins. It is in this mountainous divide that Holway has found evidence of a transfer of a part of a tributary from the Russian River to the Sacramento, which probably carried along with it a representation of the Russian River fauna.

That such a movement as Holway records could have any effect on the faunal relationships of the two basins seems highly improbable, as the Sacramento, a vastly larger and probably older system, not only contains all the fluvial species known from the Russian River, but also others not there represented. The zoological evidence, such as it is, indicates that the Russian River fauna was derived from the Sacramento, and not that any portion of the fauna of the latter was obtained from the Russian River.

[1] Holway, Ruliff S., SCIENCE, September 20, 1907.

Since the two systems are widely isolated, one can explain the identity of their faunas in so far as it exists, only by the assumption that an intermingling of their waters occurred at some past time. Several years ago attention was directed to a probable connection between



Map of the Russian River basin and parts of the Sacramento and neighboring rivers.

these basins, no reference being made at the time to their faunas. Lawson[2] in 1894 made a statement to the effect that at one time the Russian River, instead of turning abruptly westward to the ocean, continued its southward course through an uninterrupted valley to the region now occupied by San Pablo Bay. It would thus have established a main channel connection with the Sacramento, the union being perfect in case of a slight elevation of the coast which probably prevailed at that time. In this connection it should be emphasized that whatever may have been the agency for bringing about a passage between the two systems, it was apparently not able to transfer a complete representation of the Sacramento fauna to the Russian River. There are among the Sacramento fishes a considerable number of species not known in the Russian River, of which may be mentioned *Orthodon microlepidotus, Lavinea exilicauda, Pogonichthys macrolepidotus* and *Leuciscus crassicauda,* all strictly fluvial. Concerning these species two facts should be noted as having a possible bearing on the method by which the Russian River received its fish fauna: (1) they are indigenous to certain small streams which flow into San Francisco Bay[3] and they have also found their way from thence southward[4] into certain small coastal streams, where they are now abundantly able to maintain themselves; (2) they are such forms as inhabit the lower courses of the rivers, seemingly preferring the warmer, deeper and more quiet waters of the main channel. Now, if the Russian River received its fauna from the Sacramento through a main channel connection, as may be inferred from Lawson's statement, we should expect to find among its species the same channel fishes as inhabit the Sacramento and the smaller streams flowing into San Francisco Bay. They are absent, however. That they were once introduced and have since become extinct seems scarcely probable, since they are now living in the small streams referred to, under conditions apparently similar to those prevailing in the Rus-

[2] Lawson, Andrew C., "The Geomorphogeny of the Coast of Northern California," *Bull. Dept. Geol. Univ. of Cal.*, I., p. 269.

[3] Snyder, J. O., "Notes on the Fishes of the Streams flowing into San Francisco Bay, California," Rept. Com. Fish., Dept. Com. and Labor, 1904, p. 327.

[4] Branner, J. C., "A Drainage Peculiarity of the Santa Clara Valley Affecting Fresh-water Faunas," *Jour. Geol.*, XV., No. 1.

sian River. Should a part of the upper course of a tributary have been transferred from one system to the other, it would have carried with it only such forms as it harbored, thus introducing to the recipient basin a comparatively limited fauna. This condition is apparently what we find in the Russian River system. Its fauna is like that of the upper courses of the streams tributary to the Sacramento which flow from the western side of the great valley, the channel forms common to the main river being absent.

It is fair to conclude that the fish fauna of the Russian River was probably derived from the Sacramento system, and a study of the species offers the suggestion that the intermingling of their waters, by which the species were introduced, was not affected by a main-channel connection, but rather by a process of stream-robbing something like that described by Holway, only that the transfer was in the opposite direction. J. O. SNYDER

THE MOTH-PROOFING OF WOOLENS

WHEN living in Swatow, China, my house, like all dwellings within the tropics, was infested with various kinds of insects. In experimenting with diverse substances with a view to self-protection against insect pests, I found that alum was a perfect preventive of the ravages of moths among woolens.

It is well known that the female clothes-moth deposits her eggs in woolen goods, and that the worm-like larvæ hatched from these eggs subsist upon the wool until they attain the general form of the adult moth. The Chinese, who are the great practical economists of the world, do not ordinarily wear woolen garments. They are well protected from cold by an interlayer of raw cotton between the lining and the surface fabric of their winter apparel, which is often made from very light-weight silk or linen. Nevertheless, the clothes-moth is ubiquitous in China, and undisturbed woolens are soon riddled by its developing progeny.

I gave the alum a severe test by immersing picture-cords made wholly of wool, in a saturated solution for several hours, and afterward using the cords to suspend framed pictures. These cords, numbering a score or more, sustained heavy pictures for over three years, without showing sign of weakness.

A basket of soft worsteds, that I had used in testing the Chinese for color-blindness by the Seebeck and Holmgren method, were likewise treated with alum, and left uncovered and undisturbed for more than a year without attack from moths. The colors of these worsteds, although diverse and delicate, were not altered by the soaking in alum water.

Woolen shawls and other articles were fortified against moths in the same way, and remained intact for several years.

The alum does not evaporate, and is therefore permanently effective in unwashed fabrics.

There is apparently no reason why wools used in manufacturing cloth, rugs and carpets should not be so treated with alum as to become moth-proof. Crude alum is inexpensive and probably one pound of it in four quarts of water would make a solution of sufficient strength for the practical result aimed at. The commercial value of woolen goods would be enhanced by this process, and "the house beautiful" would be more easily kept.

Holland, writing of these troublesome immigrants from the old world, says ("Moths," p. 426) that the depredations of clothes-moths cost the citizens of the United States annually a sum of money which is enough in amount at the present time to pay the interest on the national debt. ADELE M. FIELDE

SEATTLE, WASH.,
November 22, 1907

PINK KATYDIDS.

TO THE EDITOR OF SCIENCE: Referring to your page 639 (Vol. XXVI.), I have captured pink katydids at East Hampton, L. I., probably on four to six different occasions in the last twenty years. One year—I should say in the seventies—I had three at one time. No one there had ever seen any—although no professional entomologist was in town. I also found one at South Lyme, Conn., in the summer of 1906. All that I have ever found were a bright shell pink. I did not note the sex of any cf my specimens, which were all

liberated after showing them to curious friends.

J. Stanford Brown

SPECIAL ARTICLES

RIGHT-HANDEDNESS AND PERIPHERAL VISION

Of right-handedness, three facts seem to be fairly well established: it is hereditary, it develops by a method of trial and error in the seventh month of life, it is due to some as yet unknown ascendency of the left hemisphere of the brain. That it is inheritable points to its origin as a congenital variation. That it develops in the seventh month of life points to its dependence upon the ripening of some bodily structure. The precise manner in which it is dependent upon the left hemisphere has never been satisfactorily explained. In fact, the very pertinent question whether the ascendency of the left hemisphere rests in the sensory or motor areas has, seemingly, never been raised. Reflection will show that the initial difference must be sensory and not motor. If the reflex act concept of the manner of working of the nervous system is correct, and if, as a consequence of that concept, currents of innervation flow only from afferent to efferent neurones, always in the "forward direction," it follows that the ascendency of the left hemisphere must, in the first instance, exist in the sensory neurones. For, the contraction of muscles of the right arm is merely a consequence of the discharge of nerve cells in the left motor cortex. But, the discharge of these cells is, again, a consequence, merely, of the discharge of sensory cells which are situated either in the sensory cortex or, possibly, in the periphery. If this reasoning is sound, it follows that where there is motor bilateral asymmetry there must first be sensory bilateral asymmetry.

Experiments[1] carried out during the past year, on the comparative sizes of objects which are seen in indirect vision, brought to light the fact that a marked difference in the perception of size exists between the right and left halves of the retinæ of the two eyes. The experiments were made with a perimeter. The objects compared were the orbits described by two black spots which were borne upon the peripheries of two slowly moving white cardboard discs. The spots were attached to movable radii so that the orbit of the apparently larger disc could be reduced until it equaled, subjectively, the orbit of the smaller. In this way, quantitative measurements were made for four meridians, vertical, horizontal and two oblique, and for three parallels of latitude, 10°, 20° and 25°, of the visual field. The observations were either (*a*) peripheral comparisons, in which the discs were situated in the periphery of the field of vision, upon some one of the four meridians, on opposite sides of the fixation point or (*b*) foveal-peripheral comparisons, in which one disc covered the fixation point and the other occupied some position in the periphery. The results of both (*a*) and (*b*) follow. (i.) The discs on the upper vertical, right-upper oblique, right horizontal and right-lower oblique meridians appear larger than similar discs symmetrically placed on opposite sides of the fixation point or at the fixation point. (ii.) This result is constant for *both* eyes. (iii.) The enlargement is greatest at 25° from the fixation point and least at 10°. (iv.) The enlargement is greater in the right-upper field than in the right-lower field. When it was seen that objects in the right half of the field of vision are imaged upon the left corresponding halves of the retinæ and that these halves of the combined eye are connected with the left occipital hemisphere, it was suggested that the illusion of size might be reversed with left-handed persons, who are, presumably, right-hemisphered. To test this point, crude observations were made with small clay discs and larger cardboard discs, placed upon a table, about 12 cm. apart, in front of the observer. The observer looked with one eye at a time, from a height of about 75 cm., at the middle point between the discs and compared, in indirect vision, their size. 183 observations were made. To 100 persons, the right disc appeared larger to both eyes. To 45 persons, the left disc appeared larger to both eyes. These results, as unequivocal, are the only ones that need be

[1] For a full report on these experiments, see a forthcoming article in *The Psychological Review*.

cited here. Of the 100 persons to whom the right disc appeared larger, 76 were right-handed, 8 ambidextrous, 16 left-handed. Of the 45 persons to whom the left disc appeared larger, 15 were right-handed, 3 ambidextrous, 27 left-handed. These results can not be considered final; but, they do seem to indicate a tendency to a relationship between the peripheral perception of size and right- and left-handedness.

Granted that such a difference in the perception of size does certainly exist between the central and peripheral parts of the retina, the sensory motive, so to call it, which in the discussion of the part played by the left hemisphere, seemed necessary to initiate right-handed movements, would be furnished. Objects situated in the right half of the field of vision of a left-hemisphered infant would, by appearing larger, attract its attention. The eyeballs would then turn, reflexly, to receive the attractive object on the fovea. Eye movements would, probably, lead to head movements, and head movements to arm movements. Just the reverse of this would happen with a right-hemisphered infant. The fact that the predominant use of the right hand is developed by trial and error, is against the assumption that there is a "natural prepotency in the paths to discharge into the right arm." If it were merely reflex, there would be no period of uncertainty in which both arms are used. A fact which supports the view suggested here is that the time (seven months) at which a pronounced right-handedness developed in Baldwin's[1] child was but little later than the time (five months) at which Raehlmann[2] found that an object was recognized when its image fell on the periphery of the retina.

H. C. Stevens

Seattle, Washington

TERTIARY DEPOSITS OF NORTHEASTERN MEXICO

The work done in the Tertiary deposits along the Rio Grande border of Texas by Dr. R. A. F. Penrose, Jr., and myself, and described in the First Annual Report of the Geological Survey of Texas and in a later paper entitled "Geology of Southwestern Texas," has been extended southward during the past year by Professor W. F. Cummins as far as the Conchas River.

He finds that the same general divisions which we have described in Texas are easily recognizable for this entire distance of more than one hundred miles, but also finds that, while a large number of the familiar forms of the Texas fossils are found in the various divisions, there are others which were not recognized there. Among these is the occurrence of a *Venericardia,* which Dr. Dall states is allied to *potapacœnsis* of the Maryland Eocene, in beds that are stratigraphically the continuation of the Marine stage of the Texas section. A number of other new forms were also found, which have not as yet been studied.

The beds of the Fayette stage which are exposed on the Rio Grande between Carrizo and Roma extend southward to Mendez on the Conchas and are characterized by the large *Ostrea alabamiensis* var. *contracta* Conrad and other forms.

The beds of the Frio stage which overlie the Fayette here, as farther north, are better exposed in this region than in Texas and carry a very distinctive fauna. Some of the forms collected at San Fernando on the Conchas River were examined by Dr. Dall, who writes that they comprise *Pecten, Arca, Clementia,* etc., and are with little doubt Oligocene. This series of beds, which Professor Cummins calls the San Fernando, was traced by him to the extreme southern limit of the Tertiary, some forty miles south of the mouth of the Soto Marina River.

Very few fossils were found in the Frio deposits in Texas and such as were determinable seemed to warrant its reference to the Eocene, but Professor Cummins's later discoveries show this to be incorrect and in place of being of Lower Claiborne age, it should be placed with the Oligocene.

E. T. Dumble

[1] "Mental Development, Methods and Processes," p. 64.

[2] Cited, without reference to the original, by Schaefer, "Text-book of Physiology," Vol. II., p. 759.

ANOPHEL. BREEDING IN SEA WATER

The leading article in the *Atti Della Società per gli Studi della Malaria* for 1907 is by Dr. W. T. de Vogel, of Samarang, Dutch East Indies, and is entitled "Anophelines in Sea Water."

Dr. Vogel shows that the investigations of several Italian workers have negatived the idea that *Anopheles* can multiply in sea water and that they have shown that the maximum proportion of sodium chloride in the water which *Anopheles* can stand is 1.87 per cent. according to Perrone, and 1.75 per cent. according to Vivante. Dr. Vogel, having made some elaborate studies in regard to malaria at Samarang, found as early as 1902 that *Anopheles* was breeding in a certain pool containing 2.8 per cent. of chloride of sodium. Later he verified these results in several interesting cases. One of these was the case of the island of Onrust, a small coral island situated two thousand meters from the mainland, and which contains no fresh water whatever. The distance from the mainland is such that even if *Anopheles* were brought from the mainland by winds they would not be numerous enough to cause much trouble. At the same time a marine station established on the island was suppressed on account of the ravages of malaria among the workmen.

He studied also the conditions in the Karimon Islands, a little archipelago in the Java Sea sixty-five kilometers from the coast. The first colonists in this archipelago were convicts and were sent there to cut down the forests of rhizopores. There were no buildings, and the convicts were forced to sleep on the earth. The mortality was between two and three thousand in two years. Later one of the officers—a man named Michalofski, a plain man but full of good sense—succeeded in putting a stop to the excessive mortality with the simple means at his disposal, by drying the sea-water pools, completely removing a part of the forest, and raising the ground on which the men slept. The success which followed these measures leads Dr. Vogel to suppose that the mortality had been caused by malaria, and this supposition is all the more probable since malaria is to-day rife among the population of the islands. He himself has visited the islands and found much malaria present. The islands themselves are principally flat, planted with cocoanut palms and surrounded by deep water, and again, at a distance of five hundred or a thousand yards from the coast, by a coral reef.

There is on the island of Grand Marimon only a single permanent source of fresh water which has only one restricted outlet; so that during the dry season there is no mingling of fresh water with sea water, and there exist during the dry season many pools of dead sea water, peopled with *Anopheles* larvæ, containing not less than three per cent. of sodium chloride, and which then must be considered as concentrated sea water.

Continuing his researches at Samarang, Dr. Vogel found other pools of water inhabited by *Anopheles* larvæ, in proximity to the sea. One of these places had a surface of 20 to 30 square meters and a depth of from 10 to 30 centimeters. It was connected with a pool of sea water by a bamboo pipe crossing the dike. The pool is thus invaded by seaweeds, but the fish can not enter. These places swarm with *Anopheles* larvæ, while *Culex* larvæ are not found there. In this pool the percentage of sodium chloride is about 2.88, while in the water of the neighboring swamps it varies between 2.44 and 2.76.

Other instances are given with careful descriptions and the author finally draws the following conclusions:

1. There are species of *Anopheles* which can live very well in sea water.

2. These mosquitoes lay eggs which develop even in sea water which has been evaporated to half its original quantity.

3. These larvæ in the gradually evaporating pools of sea water can stand an evaporation of the water to one third of its bulk, but do not appear to transform to adults if the concentration be greater than this.

4. The larvæ coming from eggs laid in sea water of high concentration can accomplish their entire metamorphoses in almost the normal time. This is true even when the water has such concentration that the development of larvæ originally hatching in un-

concentrated sea water would be retarded by this salt water.

Not only are these observations of great interest as bearing upon the health of certain seacoasts, but they have an important bearing in possibly explaining the cases of malaria observed upon sailing vessels that have not made port for months, since it indicates the possibility that *Anopheles* may breed in the bilge-water of such vessels. In such cases it is only necessary that one of the sailors should have gametes in his blood in order to start an epidemic of malaria aboard the vessel. The bad reputation which the coral islands of farther India have is explained by Doctor Vogel's observations, since so many cases of malaria are observed along the coast during the dry season when all the rivers and fresh-water streams are dried up.

The proposed destruction of *Anopheles* by the introduction of sea water seems not to be rational.

Good tidal ponds exercise a favorable influence upon the malarial death rate, but when these are infected, or even where the water is permitted to form isolated stagnant pools, the mortality from malaria reaches a high figure, as has been observed at Samarang. Villages near the sea, in the middle of tidal pools have had during a period of ten years an average mortality of from 1 to 4 per cent. each year. In villages further away from the sea, where the ponds have been abandoned or neglected and the sea water is, therefore, isolated, there is a mortality which varies from 8 to 10 per cent. each year. The pools in these regions during the dry season have a proportion of sea salt equal to that of the ocean from which they get their water. In this dry season the death rate is greatest, and this is exclusively due to the sea water ponds.

The great mortality is surely due to malaria, since almost without exception the cases of pernicious malaria or hæmoglobinuria which are treated at Samarang come from the south border of tidal pools. A quarter of Samarang called Zeestrand was inhabited by well-to-do citizens of the city who had good health, although surrounded by pools. Then, on account of the banking up of the coast, these pools were left further from the sea, and the inhabitants were forced to quit the quarter because the death rate from malaria reached terrible proportions. The empty houses of this quarter still bear witness to past grandeur. The mortality of the indigenous population which still remains there has been on the average during the last ten years 9.7 per cent. per year.

L. O. Howard

SCIENTIFIC NOTES AND NEWS

Dr. Henry Fairfield Osborn, one of the vice-presidents of the American Museum of Natural History and curator of vertebrate paleontology, has been elected president of the museum to succeed the late Morris K. Jesup.

The University of Pennsylvania will confer the degree of doctor of laws on Mr. G. K. Gilbert, of the U. S. Geological Survey, on February 22. The annual university day address will be made by the Hon. Joseph H. Choate.

Professor Robert Helmert, director of the Goedetic Institute at Potsdam, has been elected a corresponding member of the St. Petersburg Academy of Sciences.

Lord Avebury has been elected president of the Royal Microscopical Society, and will deliver an address on seeds, with especial reference to British plants, at the March meeting.

The Association of American Geographers held its fourth annual meeting at Chicago during convocation week. The sessions lasted three days, including one joint session with Section E of the American Association. Forty-four papers were presented, this being the largest number yet offered at any meeting. Since the death of the society's president, Dr. Angelo Heilprin, the duties of this office have devolved upon the first vice-president, Professor Ralph S. Tarr. Officers elected for the coming year are G. K. Gilbert, president; R. D. Salisbury, first vice-president; Ellen C. Semple, second vice-president; A. P. Brigham, secretary; N. M. Fenneman, treasurer; R. S. Tarr, member of council. It was all but formally decided to hold the next annual meeting at New Haven.

Professor D. C. Jackson, of the Massachusetts Institute of Technology, has been retained by the Massachusetts Highway Commission, to make a report regarding the telephone situation with special reference to the practicability of a reduction in rates and a higher efficiency of service.

Professor R. C. McCrea, associate director of the New York School of Philanthropy, has been appointed by the trustees of Columbia University to make a preliminary study of humane societies and instruction in humanity, in view of the recent endowment of $100,000 to establish a chair in this subject.

The Rev. J. B. McClellan, M.A., has resigned the principalship of the Royal Agricultural College, Cirencester, after more than a quarter of a century's service.

The British secretary of state for the colonies has sent Dr. W. J. Simpson, professor of hygiene at King's College, London, and lecturer in tropical hygiene at the London School of Tropical Medicine, to the Gold Coast to assist in combating the present outbreak of bubonic plague at Accra.

Dr. W. S. Bruce, of the Scottish Oceanographical Laboratory, has received information from Buenos Aires to the effect that the ship *Austral* was getting ready to go south. Mr. Davis, of the Argentine Meteorological Office, will probably have another meteorological and magnetic station set up on Wandel Island for the coming year.

Under the auspices of the Sigma Xi scientific society of the University of Kansas, Professor Russell H. Chittenden, director of the Sheffield Scientific School of Yale University, will deliver two popular lectures at the University on February 17 and 18.

Dr. Lucien I. Blake, formerly professor of physics in the University of Kansas, will give a course of lectures upon electrical subjects before the students in electrical engineering at the university, during the last week in February. Aside from the technical lectures, Mr. Blake will deliver three popular lectures for the general public.

Arrangements have been made by the American Society of Naturalists to celebrate the one hundredth anniversary of Charles Darwin, in cooperation with the American Association for the Advancement of Science, on the occasion of their meetings in Baltimore in 1908. The Society of Naturalists will be represented on the Committee of Arrangements by the president, the secretary and several members.

A bust of A. Kekulé, eminent for his work at Bonn on organic chemistry, has been presented to the Worcester Polytechnic Institute by Dr. George D. Moore, formerly assistant professor of chemistry, and has been placed in one of the museums of the chemical department.

Mr. James Wallace Pinchot, who took an active interest in art and science, especially in forestry, and made liberal contributions for their support, died in Washington on February 6, at the age of seventy-six years.

Mr. Richard Hinckley Allen, of Chatham, N. J., died on January 14 at Northampton, Mass. Mr. Allen will be remembered as the author of "Star Names and their Meanings," a work of wide and scholarly research, and lasting value. Mr. Allen was a member of the American Association for the Advancement of Science and of the Astronomical Society of the Pacific, and the National Geographical Society.

Sir Thomas McCall Anderson, regius professor of medicine in the University of Glasgow, and an authority on diseases of the skin, died on January 25 at the age of seventy-one years.

Professor James Bell Pettigrew, M.D., LL.D., Chandos professor of anatomy and medicine in the University of St. Andrews, died on January 30 at the age of seventy-three years. He was the author of numerous contributions to medicine and other scientific subjects, being the author of a book on "Animal Locomotion" and of various papers concerned with flying machines.

Dr. Adolf Paalzow, formerly professor of physics in the Technological Institute at Charlottenburg, has died at the age of eighty-four years.

WE regret also to record the death, at the age of seventy-seven years, of Professor Vaclav K. Zengler, the Bohemian physicist and meteorologist, and of Dr. Chapot Prévost, professor of histology in Rio Janeiro.

THE following letter from the University of London, signed by Lord Rosebery, chancellor; W. J. Collins, vice-chancellor; Edward H. Busk, chairman of convocation, and Arthur W. Rücker, principal, has been sent to the vice-chancellor and principal of the University of Glasgow:

We are desired by the senate of the University of London, who met yesterday [January 22] for the first time after the Christmas vacation, to tender to you, and through you to the University of Glasgow at large, an expression of our sincere sympathy in the loss which you have suffered by the death of your chancellor. Lord Kelvin's researches into the operations of nature and his contributions to the sum of human knowledge, by which the work of all the universities of the civilized world has been so notably advanced, have given additional luster to the illustrious name of the University of Glasgow. It must ever remain to you a source of the proudest satisfaction that a career nobly and beneficently devoted to the welfare of humanity was throughout associated with the body over which he was presiding when the world lost him. We are proud to remember on this occasion that Lord Kelvin was one of the only two men, outside the circle of royalty, upon whom the University of London has ever conferred an honorary degree.

AT a meeting of the American Ethnological Society the following resolutions were adopted:

WHEREAS: The American Ethnological Society has suffered a severe loss by the death of Morris K. Jesup, its honorary president, its former president, and one of its honored members; and

WHEREAS: Through his wide sympathies and active cooperation, he has advanced the well-being of his fellow-citizens and the interests of science and art, and has placed the science of anthropology under lasting obligations by his generous support of the anthropological work of the American Museum of Natural History, by his maintenance of researches bearing upon anthropological problems, and by enlisting the interests of others in similar work; and

WHEREAS: He organized and maintained, partly alone, partly in cooperation with his friends, researches in Mexico, Central and South America, among the Indians of our western states, on the Pacific coasts of America and Asia, in Siberia, and in southeastern Asia, and gave liberally to these enterprises, not only of his wealth, but also of his wide experience and wise counsel: therefore be it

Resolved, That the American Ethnological Society wishes to express the sense of the great loss it has sustained by the death of one whose services to the science of anthropology will long live in the records of the researches that were undertaken at his instance.

Resolved, That a copy of these resolutions be sent to the family of the deceased.

THE Sheffield Scientific School, Yale University, has subscribed for a research room at the Marine Biological Laboratory, Woods Hole, Mass. It is expected that this will be an annual contribution, which will insure one research room for the use of some member of the biological staff.

A JOINT resolution presented to the House of Representatives by Mr. Mann, authorizing the presentation of the statue of Washington, now located in the capitol grounds, to the Smithsonian Institution, has been referred to the committee on the library.

THE permanent endowment fund of the American Museum of Natural History has been increased by a gift of $10,000 from Mrs. J. B. Trevor, and by the payment of a bequest of $25,000 from the estate of William P. Davis, Esq. H. W. Seton-Karr, Esq., of Wimbledon, England, has presented to the department of archeology seventy-one specimens of paleolithic implements collected by him in the districts of Poondi and Cazeepet, Madras Presidency, India. These implements are of red argillaceous sandstone and were washed out of Pleistocene alluvial deposits containing quartzite boulders. The department has received from Mr. Alanson Skinner a series of specimens collected for the museum last year in Ontario, Livingston and Erie counties, New York, from sites formerly occupied by the Seneca and Neutral Indians of Iroquoian stock.

THE Brazilian government has voted funds for the establishment of an experimental pathological institute at Manguinhos, intended

for the study of the parasitic and infectious diseases of man, animals and plants, and for the preparation of serums.

The foundation stone of an institute for the teaching of the history of medicine in connection with the University of Vienna will, says the *British Medical Journal,* shortly be laid. The state has promised a subvention, and the medical profession has contributed with a generous hand. In the institute there will be a museum containing collections of all sorts of things relating to medical history—portraits, books, instruments, apparatus, etc. One section of this will be devoted to a collection showing the development of the healing art in Austria. The establishment of the institute is due to the untiring efforts of Professors Neuburger and von Töply, both of whom have won deserved fame as medical antiquarians.

In October, 1891, Thomas George Hodgkins, of Setauket, New York, made a donation to the Smithsonian Institution, the income from a part of which was to be devoted to "the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man." In the furtherance of the donor's wishes, the Smithsonian Institution has from time to time offered prizes, awarded medals, made grants for investigations and issued publications. In connection with the approaching International Congress on Tuberculosis, which will be held in Washington, September 21 to October 12, 1908, a prize of $1,500 is offered for the best treatise that may be submitted to that Congress "On the Relation of Atmospheric Air to Tuberculosis." The treatises may be written in English, French, German, Spanish or Italian. They will be examined and the prize awarded by a committee appointed by the Secretary of the Smithsonian Institution in conjunction with the officers of the International Congress on Tuberculosis. The right is reserved to award no prize if in the judgment of the committee no contribution is offered of sufficient merit to warrant such action. The Smithsonian Institution reserves the right to publish the treatise to which the prize is awarded.

Professor H. McE. Knower, Secretary of the American Society of Naturalists, has sent the following resolution, adopted by the council of the society, advocating a biological survey of the Panama Canal zone:

Realizing that the work in the Panama Canal is changing biological conditions in Panama and that the completion of the Canal will enable the fresh-water faunæ of the two slopes to mingle freely and that many marine animals will succeed in passing the completed Canal, the American Society of Naturalists urges upon the President and Congress to make provision for a biological survey of the Panama Canal zone.

Since the conditions will be permanently changed as soon as the Canal is completed and the work can not be satisfactorily done after the completion of the canal, there is great urgency that provision for the work be made at once.

Resolved, That the secretary be instructed to send copies of this resolution to the President, the Vice-President, the Speaker of the House and the Secretary of the Smithsonian Institution.

Nature says: "Last spring Dr. J. Elberts, the German geologist, conducted an expedition to investigate further the fossiliferous deposits of the Bengawan River, near Trinil, in Java, rendered famous by the discovery of *Pithecanthropus erectus* by Dr. Eugene Dubois in 1891–2. Although extensive collections were made and fresh forms discovered, no trace of *Pithecanthropus* was found; but, according to the correspondent of the *Pall Mall Gazette* (January 17), Dr. Elberts found roughly fashioned implements of bone, "a fireplace, and the remains of extinct animals, from which he became convinced that the ape-man must have existed at a remoter period." Unfortunately, this statement is so vague that nothing can be accepted until more information comes to hand. The implication is that some beings made fires and cooked animals, now extinct, before the gravel beds were deposited which contain *Pithecanthropus* and other extinct forms. In the province of Madium a fireplace was discovered 20 feet below the surface containing stone arrow-heads and fragments of pottery, broken and partly burned bones, and charred

teeth of a fossil buffalo, together with the bones of deer, pigs, and a fossil elephant (*Stegodon*); some of these bones had been split open in order to extract the marrow. Dr. Elberts computes that these people lived 20,000 years ago, but, as the correspondent of the *Pall Mall Gazette* does not give the data upon which this estimation is based, this date must await the publication of all the facts. It is evident that we may congratulate our German colleagues on having discovered remains of early inhabitants of Java who were apparently in their "Neolithic" stage of culture. It is to be hoped that when the finds are published in full it will be possible to learn what manner of men they were. We understand that the expedition is now in south Sumatra, where fossil plants will also be collected, in the hope of determining whether Sumatra had an Ice age."

ON January 21, Lord Lister was enrolled as an Honorary Burgess of the City of Glasgow. According to the account in the *British Medical Journal* the lord provost, Sir William Bilsland, who presided at the ceremony, recalled Lord Lister's connection with the city while professor of surgery at the university and visiting surgeon at the royal infirmary. It was at Glasgow that he achieved world-wide distinction as a scientist and a surgeon by his discovery which had saved thousands of lives and greatly lessened human suffering. It had been well said that Lord Lister's work marked a new epoch in modern surgery, and his name would have an imperishable place alongside the greatest in his profession and among the noblest benefactors of humanity. Professor Sir Hector Cameron accepted on behalf of Lord Lister, who was unable to be present, the casket containing the burgess ticket, and read from him a letter recalling his connection with the University and the city, in the course of which he said: "Having in due time been elected by the managers of the Royal Infirmary as surgeon to that institution, I experienced uniform consideration at their hands when applying to the treatment of wounds the great truth which had been recently revealed by the illustrious Pasteur regarding the nature of fermentative changes in organic substances. That truth, though it seemed to me to shine clear as daylight from Pasteur's writings, was for many years not generally recognized, and thus it was my privilege to witness in my own practise, as the application of the principle became gradually improved, the revelation of pathological truths of fundamental importance and a revolution in practical surgery, and I look upon the years spent in your city as the happiest period in my life. The old infirmary is now giving place to more commodious buildings; and, great as must necessarily be the expense in this undertaking, I do not doubt that the proverbial liberality of Glasgow will prove fully equal to the occasion."

DURING the last year hydrologists of the U. S. Geological Survey have been making a study of the quality of the water of Lehigh River. The chief purpose of this work is to determine the nature and extent of the variations in the character of the water at different seasons of the year and its suitability for use by manufactories and for domestic purposes. At the same time the studies made show what minerals are dissolved from the soils of the Lehigh Valley and the quantity of each. Samples of the river water have been collected from day to day at South Bethlehem and shipped to the survey's laboratory at Washington, D. C., where chemists have submitted it to critical analysis. These studies are still unfinished, but many conclusions regarding the stream have been reached. It is shown, for example, that each year about 270,000 tons of dissolved minerals are carried past South Bethlehem. Of this quantity 10.2 per cent. is silica, the chief constituent of sand and of most rocks; more than 15 per cent. is calcium, washed into the stream as sulphate and carbonate of lime; nearly 6 per cent. is magnesium; nearly 8 per cent. is sodium, one of the constituents of common salt; only 1 per cent. is iron. The grand total of the minerals borne by the stream is made up of the metals named, carried in combination as sulphates, carbonates, chlorides and nitrates. The sulphate compounds are the chief constituents, amounting to about 116,000 tons a year; the

carbonates are next in rank, aggregating about 86,000 tons a year.

The report of the commissioner of patents for the fiscal year ending June 30, 1907, has been issued. According to the abstract in the *Electrical World,* there was filed a total of 66,795 applications, including 56,514 for mechanical patents; 816 for designs; 192 for reissues; 7,869 for registration of trade-marks; 982 for registration of labels and 422 for registration of prints. In addition to these applications, there were filed 1,900 caveats. There were issued 33,644 mechanical patents; 529 design patents; 165 reissues; and there were registered 8,798 trade-marks, 660 labels and 325 prints. The number of patents which expired was 25,322, while 4,707 letters patent were withheld for non-payment of the final fees; 14,565 applications were allowed, and awaiting the payment of the final fees. The total receipts of the office from all sources amounted to $1,859,592.89 for the fiscal year, of which there were expended $1,584,489.70, including $932,665.59 for salaries, leaving a surplus of $275,103.19, turned into the United States Treasury. The total net surplus of receipts over expenditures in the Treasury to the credit of the Patent Office on January 1, 1908, was $6,706,181.64, an amount derived entirely from the fees paid since 1837.

UNIVERSITY AND EDUCATIONAL NEWS

The graduate school of the University of Illinois was formally opened on February 4, when President G. Stanley Hall, of Clark University, made the opening address. This was followed by an address by Dean West, of Princeton University. The legislature of Illinois has appropriated the sum of $50,000 a year for the next two years for developing the graduate school. This is said to be the first appropriation specifically for graduate work in a state university.

Harvard University has established twenty-five additional university scholarships of $150 each, to be assigned annually, to seniors of high standing in Harvard and other colleges. These scholarships are to be awarded for study in the Graduate School of Arts and Sciences during the next academic year.

Large public bequests are made by the will of the late Miss Alice Byington, of Stockbridge, Mass., including $50,000 to the Tuskegee Institute and $160,000 to the Hampden Normal and Agricultural School.

A research fellowship in chemistry has been founded by the trustees of Bryn Mawr College and filled for this semester by the appointment of Miss Mary Cloyd Burnley, a former fellow, now of Vassar College.

Manchester University is to receive £12,000 by way of special grant from the treasury for the current year, instead of the reduced sum of £10,000.

The trustees of Columbia University have revised the statutes so that after six years of service a professor or adjunct professor may have leave of absence for one half year with full salary. Hitherto the statutes have permitted a sabbatical year's leave of absence on half salary.

At Syracuse University Dr. John L. Heffron has been appointed dean of the College of Medicine to succeed the late Gaylord P. Clark.

Dr. Benjamin Migne Duggar, formerly of Cornell, since 1902 professor of botany at the University of Missouri, has returned to Ithaca as professor of plant physiology in the State College of Agriculture.

Mr. W. S. Lozier, formerly instructor at the Pennsylvania State College, has been appointed instructor in engineering in the School of Applied Science of New York University.

Mr. W. W. Wallace has been appointed head of the department of applied mechanics in Liverpool University.

Mr. David K. Picken, M.A., chief assistant to the professor of mathematics, Glasgow University, has been appointed professor of mathematics in Victoria College, Wellington, N. Z.

Dr. R. Funter, docent at Marburg, has been appointed professor of mathematics at Basel.

Dr. L. Jost, acting professor in the Agricultural Academy at Poppelsdorf, has been appointed professor of botany at Strasburg.